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City of Spokane Combined Sewer Overflow Abatement Project

(U.S.) Environmental Protection Agency, Seattle, WA Region X

Jan 79

EPA 910/9-78-053

United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

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Water

January 1979

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Environmental Impact Statement

Draft

City of Spokane Combined Sewer Overflow Abatement Project

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PERFORMER: Environmental Protection Agency, Seattle, WA.
Region X.
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Prepared in cooperation with Jones and Stokes Associates, Inc., Sacramento, CA., and Culp/Wesner/Culp, Santa Ana, CA.

The objective of this project is to provide a means of abating the combined sewer overflows (CSO's) in the City of Spokane. At present, the interceptor system in the city is unable to transport all of the sewage and stormwaters to the sewage treatment plant. The system overflows the excess into the Spokane River at over 30 points in the city. The issues in this project involve the effects CSO's have on nutrient loading, bacterial contamination and aesthetic impairment of the Spokane River. Construction related impacts are also a concern in this project.

KEYWORDS: *Pipelines, *Sewage treatment, *Environmental impact statements-draft, *Construction, *Sewage treatment plants.

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

City of Spokane
Combined Sewer Overflow
Abatement Project

Prepared by
U.S. Environmental Protection Agency
Region 10
Seattle, WA 98101

With Technical Assistance from
Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

In Association With
Culp, Wesner and Culp

Responsible Official:

Donald P. Dubois
Regional Administrator

1979

Date

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SUMMARY
DRAFT ENVIRONMENTAL STATEMENT - CITY OF SPOKANE COMBINED SEWER OVERFLOW ABATEMENT PROJECT

Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

1. Type of Statement: Draft (X) Final ( )

2. Type of Action: Administrative (X) Legislative ( )

3. Description of Action:

The objective of this project is to provide a means of abating the combined sewer overflows (CSO's) in the City of Spokane. At present, the interceptor system in the city is unable to transport all of the sewage and stormwaters to the sewage treatment plant. The system overflows the excess into the Spokane River at over 30 points in the city.

The issues in this project involve the effects CSO's have on nutrient loading, bacterial contamination and aesthetic impairment of the Spokane River. Construction related impacts are also a concern in this project.

4. Alternatives Considered:

The EIS provides a full environmental analysis of seven major alternatives or suboptions. A brief description of each of these alternatives follows. The possibility of making Spokane's interceptors and treatment plant a regional facility is also discussed.

Alternative 1

CSO would be controlled by constructing 14 underground storage basins at key overflow points. Interceptor overflows would be stored during peak runoff and fed back into the system after peak flows had subsided. The drainage problem would be remedied by the construction of 55 miles of relief sewers throughout the city. The city facilities plan recommended construction of storage basins large enough to allow only one overflow to the river in 25 years on the average. This report also analyzes smaller storage basins that would allow one overflow per year on the average.

Alternative 2

Fourteen small underground treatment plants would be constructed to provide primary treatment and chlorination to the CSO. They would be located in the same general area as the storage basins of Alternative 1. The 55 miles of relief sewers would also be needed to solve local drainage problems.

Alternative 3

Up to 220 miles of storm sewers would be constructed to separate sanitary wastewater from storm runoff. This would eliminate raw wastewater overflows but would continue storm runoff discharges to the river. Stormwater discharges are likely to occur on 80 to 110 days of the year, depending upon the frequency and intensity of local precipitation. The wastewater-stormwater separation would solve most local drainage and sewer backup problems.

Klicker Plan

The Klicker Plan is a modification of Alternative 1. Smaller underground storage basins would be used and surface lagoons would be added to catch peak flows from the 5-year frequency storm. A large storage reservoir would be constructed south of Bridge Street to replace a site proposed near Downriver Golf Course in Alternative 1; this reservoir site might also eventually act as a wastewater treatment facility once the main Spokane plant reaches its maximum capacity.

Drainage problems would be controlled by installation of on-site check valves and storage tanks at those locations now suffering backups. An estimated 700 residences or businesses would be affected.

Latenser Plan

This plan is also a modification of the storage concept. Rather than having numerous storage sites downtown along the Spokane River, increases in pumping capability and rerouting of storm flows would allow transport of all CSO to a large open storage reservoir in Riverside State Park across from the city treatment plant. Untreated combined sewage would be held in this reservoir until it could be trickled back into the plant for treatment. Pumping and storage facilities would be sized to allow one overflow to the river per year on the average.

This plan would also change the location of disposal for all Spokane treatment plant effluent. The plant's phosphorus removal equipment would be abandoned and secondary effluent would be exported out of the Spokane River basin for irrigation reuse in the Crab Creek drainage basin near Odessa.

A Combination Pollution Control and Drainage Concept

This alternative combines elements of Alternatives 1 and 3. The cost of storage vs. separate sewering was compared individually for each of the 15 drainage areas in the city. The control method with the lowest annual cost was selected as the most effective solution for each individual basin. Storage plus relief sewers was selected for 7 of the basins and separate storm sewers was selected for the other 8 (see Appendix C). Storage basins were sized to allow one untreated overflow per year on the average. Relief sewers would be used for correction of drainage problems in those areas served by storage rather than separate storm sewers.

No-Action

The "do nothing" or "no-action" alternative is analyzed in the EIS as mandated by the EPA guidelines for preparation of an EIS. This alternative eliminates construction and would allow continuation of periodic discharge of untreated combined sewer overflows to the Spokane River in violation of the city's NPDES permit.

County Regionalization

The ability of the Spokane treatment plant to receive wastewater from outlying county areas was given a very general fiscal and operational feasibility analysis in this EIS. Tying in North Spokane and Spokane Valley was considered in relation to the city system's hydraulic capacity and life expectancy. The influence of regionalization on allocation of project costs is also discussed. Spokane County is proposing to conduct a new regional wastewater facilities planning effort for the entire metropolitan Spokane area in 1979. This effort will include a detailed analysis of the feasibility of making the Spokane treatment plant a regional facility. In June 1978, the City and County of Spokane issued a joint resolution of cooperation in planning and developing water and sewer service for the metropolitan Spokane area. This included a statement that the county "can and will avail itself" of Spokane treatment plant capacity "when it is proven to be the most reasonable, environmentally and economically feasible alternate".

5. Summary of Environmental Impacts and Adverse Environmental Effects

The principal construction impacts are those associated with laying up to 220 miles of pipes throughout the city and/or impacts related to construction of storage reservoirs. All of the alternatives except the No Action and the Latenser alternatives would remove about the same amount of waste-related pollutants from the Spokane River. The No Action alternative would not result in any changes to the existing conditions. The Latenser alternative, as an effluent export plan for the city's entire waste stream, would remove over 90% of the city's current discharges to the river. Improvement of aesthetic values and beneficial uses would result from all of the alternatives, except No Action, in varying degrees. The complete sewer separation project would effectively eliminate raw sewage from the river while those options involving storage basins would result in occasional combined sewer overflows. Chapter 1, the report summary, describes the above information in greater detail.

6. A list of Federal, State and local agencies contacted on this project can be found on pages 227-230. A list of preparers is located on page 231. All persons and agencies on these lists were invited to comment on the Environmental Impact Statement.

Chapter 1

REPORT SUMMARY

Project Background

Although the City of Spokane completed an advanced wastewater treatment plant in 1977, the city still does not comply with their National Pollutant Discharge Elimination System (NPDES) waste discharge permit issued by the Washington Department of Ecology, because untreated sewage enters the Spokane River with almost every rainstorm or snowmelt. The new plant, which provides secondary and advanced wastewater treatment through phosphorus removal, is desigend to serve the people of Spokane and possibly the surrounding area into the next century. The problem of untreated sewage flowing into the river is not associated with the plant, but with the city collection and conveyance system in that the pipes are too small to convey all of the combined sewage and stormwater to the treatment plant. Consequently, to gain relief for the conveyance system and abate flooding, the combined sewage and stormwater are discharged to the river - a problem commonly referred to as CSO, i.e., combined sewer overflow. CSO can be hazardous to public health, cause water pollution and nuisances. The city's NPDES permit specified cleanup of all CSOs by June 30, 1977. The city is in the process of developing and funding a system to control CSO and drainage that will comply with the Environmental Protection Agency (EPA) and the Department of Ecology (DOE) requirements.

Project Environmental Goals and Constraints

The city's CSO abatement project has three goals: 1) to eliminate the discharge of untreated wastewater to the Spokane River, making it more suitable for a variety of uses, 2) to remedy local drainage problems in the city which frequently cause basement and street flooding, property damage, cleanup costs and a public health hazard, and 3) to maintain as a future option, the ability to use the existing wastewater treatment plant as a regional facility. The city's plans to achieve these goals are controlled by state and federal regulations and grant funding conditions. In order for the project to receive federal and state grants, EPA and DOE must ensure that it does not conflict with existing environmental laws and regulations, including the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act and the State Water Quality Standards. Before EPA can participate in the funding of a project in Spokane, it must be assured that the selected project complies with the water pollution abatement mandates of the Clean Water Act. In Spokane's case this means that CSOs must be reduced to a point that they no longer interfere with the prescribed beneficial uses of the Spokane River. The DOE must insure that the selected project is capable of complying with the city's NPDES permit, which calls for eventual elimination of all CSO to the river.

Necessity For and Purpose of the Environmental Impact Statement

The National Environmental Policy Act of 1969 (NEPA) requires all federal agencies which propose actions that would significantly affect the quality of the human environment to prepare an Environmental Impact Statement (EIS) on these actions. The EIS is intended to be a "full disclosure" of impacts which would result from a project or action, and must follow specific guidelines established by the Council on Environmental Quality(CEQ). In the selection of a combined sewer overflow abatement plan, it is the intent of NEPA that alternatives be evaluated and a plan be selected on the basis of all environmental considerations, not just monetary costs.

The Facilities Plan Draft EIS is a required element of EPA's action on the Spokane CSO abatement project. Under terms of Section 201 of the Clean Water Act, local facilities construction projects are eligible to receive up to 75 percent federal funding for the planning, design and construction of municipal wastewater treatment systems. The State of Washington, through the DOE, also makes grants of up to 15 percent available for such projects. The minimum local share on those features of a project eligible for EPA and DOE funding is therefore 10 percent. Eligibility is based largely on EPA regulations and guidance memoranda. Before the grant funds are made available, EPA and DOE must consider the environmental consequences of the proposed project and its viable alternatives. This EIS has been prepared to identify the costs and environmental impacts and to encourage public participation in the planning process through local meetings and public hearings.

Alternative Solutions

The EIS provides a full environmental analysis of seven major alternatives or suboptions. A brief description of each of these alternatives follows. The possibility of making Spokane's interceptors and treatment plant a regional facility is also discussed.

Alternative 1

CSO would be controlled by constructing 14 underground storage basins at key overflow points. Interceptor overflows would be stored during peak runoff and fed back into the system after peak flows had subsided. The drainage problem would be remedied by the construction of 55 miles of relief sewers throughout the city. The city facilities plan recommended construction of storage basins large enough to allow only one overflow to the river in 25 years on the average. This report also analyzes smaller storage basins that would allow one overflow per year on the average.

Alternative 2

Fourteen small underground treatment plants would be constructed to provide primary treatment and chlorination to the CSO. They would be located in the same general area as the storage basins of Alternative 1. The 55 miles of relief sewers would also be needed to solve local drainage problems.

Alternative 3

Up to 220 miles of storm sewers would be constructed to separate sanitary wastewater from storm runoff. This would eliminate raw wastewater overflows but would continue storm runoff discharges to the river. Stormwater discharges are likely to occur on 80 to 110 days of the year, depending upon the frequency and intensity of local precipitation. The wastewater-stormwater separation would solve most local drainage and sewer backup problems.

Klicker Plan

The Klicker Plan is a modification of Alternative 1. Smaller underground storage basins would be used and surface lagoons would be added to catch peak flows from the 5-year frequency storm. A large storage reservoir would be constructed south of Bridge Street to replace a site proposed near Downriver Golf Course in Alternative 1; this reservoir site might also eventually act as a wastewater treatment facility once the main Spokane plant reaches its maximum capacity.

Drainage problems would be controlled by installation of on-site check valves and storage tanks at those locations now suffering backups. An estimated 700 residences or businesses would be affected.

Latenser Plan

This plan is also a modification of the storage concept. Rather than having numerous storage sites downtown along the Spokane River, increases in pumping capability and rerouting of storm flows would allow transport of all CSO to a large open storage reservoir in Riverside State Park across from the city treatment plant. Untreated combined sewage would be held in this reservoir until it could be trickled back into the plant for treatment. Pumping and storage facilities would be sized to allow one overflow to the river per year on the average.

This plan would also change the location of disposal for all Spokane treatment plant effluent. The plant's phosphorus removal equipment would be abandoned and secondary effluent would be exported out of the Spokane River basin for irrigation reuse in the Crab Creek drainage basin near Odessa.

A Combination Pollution Control and Drainage Concept

This alternative combines elements of Alternatives 1 and 3. The cost of storage vs. separate sewering was compared individually for each of the 15 drainage areas in the city. The control method with the lowest annual cost was selected as the most effective solution for each individual basin. Storage plus relief sewers was selected for 7 of the basins and separate storm sewers was selected for the other 8 (see Appendix C). Storage basins were sized to allow one untreated overflow per year on the average. Relief sewers would be used for correction of drainage problems in those areas served by storage rather than separate storm sewers.

No-Action

The "do nothing" or "no-action" alternative is analyzed in the EIS as mandated by the EPA guidelines for preparation of an EIS. This alternative eliminates construction and would allow continuation of periodic discharge of untreated combined sewer overflows to the Spokane River in violation of the city's NPDES permit.

County Regionalization

The ability of the Spokane treatment plant to receive wastewater from outlying county areas was given a very general fiscal and operational feasibility analysis in this EIS. Tying in North Spokane and Spokane Valley was considered in relation to the city system's hydraulic capacity and life expectancy. The influence of regionalization on allocation of project costs is also discussed. Spokane County is proposing to conduct a new regional wastewater facilities planning effort for the entire metropolitan Spokane area in 1979. This effort will include a detailed analysis of the feasibility of making the Spokane treatment plant a regional facility. In June 1978, the City and County of Spokane issued a joint resolution of cooperation in planning and developing water and sewer service for the metropolitan Spokane area. This included a statement that the county "can and will avail itself" of Spokane treatment plant capacity "when it is proven to be the most reasonable, environmentally and economically feasible alternate".

Major Environmental Issues

The CSO abatement planning process has uncovered a variety of significant environmental issues related to the proposed alternatives. Each of the issues is discussed in-depth in Chapter 4 of this EIS. In response to recently proposed changes in the format and content of EISs (Federal Register, Volume 43, No. 112, Friday, June 9, 1978), the impact analysis has focused on the issues of major consequence. The following paragraphs summarize the impact analyses and findings included in Chapter 4.

Disruptions Caused by Construction Activities

Alternative 1. Construction disruptions would occur at scattered locations throughout Spokane under Alternative 1. Storage basin construction would affect residential areas in Peaceful Valley and along Northwest Boulevard, Upriver Drive and Riverton Street. Some houses would probably be removed in Peaceful Valley. Several recreation areas would also be affected, including Downriver Golf Course, Riverside State Park, Riverfront Park, Mission Park, High Bridge Park and Glover Field. The construction activity would last up to 1 1/2 years at some sites.

Construction of relief sewers (55 miles) would increase traffic and access problems, noise and dust in front of commercial developments on Division Street and at Manito, Eastown and Shadle shopping centers. Scattered residential areas and several schools and hospitals would also be affected, but construction at any one location should not last more than 1 to 3 weeks. Major areas of construction disruption are summarized in Table 1-1.

Table 1-1

MAJOR AREAS OF CONSTRUCTION ACTIVITY DISRUPTION

	LAND USE TYPE				
Alternative	Residential	Commercial	Industrial	Parks/Recreation	Public/Semipublic Facilities
Alternatives 1 and 2	Northwest Blvd., Peaceful Valley, Upriver Drive, Riverton St.	Downriver Golf Course, N. Division St., Shadle Center, Eastown Center, Manito Center	Regal & Garland, Trent & Erie to Napa & Trent	Downriver Golf Course & Park, Riverfront Park, Mission Park, High Bridge Park, Liberty Park, Underhill Park, Manito Park, Glover Field, Rochester Heights, Harmon Field	Holy Family Hospital, Garland School, Continuation High School, Spokane Branch Library, Cedar St. Fire Station, Rockwood Park Clinic, Rivercrest Convalescent Hospital
Alternative 3	Most Residential Areas	Downriver Golf Course, Manito Center, Garland St., Central Business Dist., Shadle Center, Eastown Center	Most Industrial Areas	Downriver Golf Course, Most Parks, including Riverfront, High Bridge, Mission, Franklin, Shadle, Manito, Playfair Race Track	Civic Theater, Holy Family Hospital, Coliseum, Spokane Branch Library, Federal Bldg., Opera House, Convention Center, Deaconess Hospital, Most Schools
Latenser Plan	NE Spokane, Peaceful Valley	N. Division St., Shadle Center, Eastown Center, Manito Center, Agricultural Areas West of Spokane	Regal & Garland, Trent & Erie to Napa & Trent	Riverside St. Park, Liberty Park, Underhill Park, Manito Park, Glover Field	Holy Family Hospital, Garland School, Continuation High School, Spokane Branch Library, Cedar St. Fire Station, Rockwood Park Clinic
Klicker Plan	Northwest Blvd., Peaceful Valley, Upriver Drive, Riverton St., Bridge St.	Downriver Golf Course		Downriver Golf Course & Park, Riverfront Park, Mission Park, High Bridge Park	Rivercrest Convalescent Hospital
Combination Concept	Peaceful Valley, Northwest Blvd., Riverton St., Residences around Mission & Chief Garry Parks	Downriver Golf Course, Shadle Center, Manito Center, Eastown Center	Regal & Garland, Trent & Erie to Napa & Trent	Downriver Golf Course & Park, Chief Garry, Mission and Riverfront Parks	Garland School, Continuation High School, Rivercrest Convalescent Hospital, Spokane Branch Library, Fire Station, Rockwood Park Clinic, Holy Family Hospital
No Action	None				

Alternative 2. Alternative 2 construction would be very similar to that of Alternative 1 except that satellite treatment plant construction would affect a smaller area than storage basin construction. The construction period would also be shorter.

Alternative 3. This alternative would create the most widespread disruption of any of the CSO abatement plans. Most construction would be confined to roadways, but up to 220 miles of pipeline would be laid over an 8- to 10-year period. The length of construction activity at any given location would be quite short (1 to 3 weeks), but most residential, commercial, industrial and recreational areas in town would be adversely affected at one time or another. Traffic disruptions would be significant. The city's central business district would be seriously impacted as construction is planned for most of the major streets in the downtown area. Nuisance noise and dust, and periodic traffic congestion would probably reduce business activity during the construction period. Outlying shopping areas (Shadle, Manito, Eastown, Garland Street) would also be impacted by storm sewer construction. Most of the city's major parks (including Riverfront and Manito) and most schools and hospitals would be adjacent to construction at some time during the life of the project.

Klicker Plan. Construction disruptions would occur in most of the same locations as described for Alternative 1 storage basins, but the area affected would probably be larger due to surface lagoon construction. A major reservoir would also be placed in an open area south of Bridge Street just across the river from Peaceful Valley. Housing removal in Peaceful Valley would probably be more extensive than required for Alternative 1. Relief sewer construction would not occur; it would be replaced by construction of about 700 on-site check valves and storage basins. Only those residences/businesses receiving on-site systems would be affected.

Latenser Plan. The Latenser Plan is also a storage option, but storage basin construction downtown would be avoided in favor of erecting several large pump stations in Peaceful Valley and on Trent Street where it crosses the Spokane River. Some separate storm sewers would be constructed on the eastern city fringe and a major pipeline and storage reservoir would be built in Riverside State Park south of the river and downstream from Fort Wright Bridge. Commercial activity and traffic disruptions in the downtown area would be minimized. A major pipeline and storage area would also be constructed on farmland west of the city. The disruptions in this area should be minimal.

Combination Concept. Construction of small storage basins at sites 5B, 6B, 8B, 10B, 14B and 16B (Figure 2-3), and construction of storm sewers in drainage areas 1, 2, 3, 4, 7, 9, 11 and 13 (Figure 2-7) would create a combination of short-term impacts previously described for Alternatives 1 and 3. Storage basin construction at Riverfront Park (6B), Peaceful Valley (8B), Northwest Boulevard (14B) and Riverton Drive (3B) would create the greatest adverse impact.

No Action. There would be no construction activity under a "no-action" plan.

Economic and Employment Effects of Construction

The construction activity required for each alternative would stimulate local business by employing construction workers and increasing sales of building materials, equipment, tools and supplies. The projects with the largest construction budgets would obviously create the largest stimulus to the local economy. Employment and building materials sales estimates are summarized in the following table.

Table 1-2

	Estimated Length of Construction	Percent Annual Increase in Local Construction Employment	Dollars Spent on Building Materials
Alternative 1	2-3 yrs.	76-114	$33,907,000
Alternative 2	2-3 yrs.	72-107	31,620,000
Alternative 3	8-10 yrs.	15-19	21,000,000
Klicker Suboption	2-3 yrs.	45-68	18,161,400
Latenser Plan	2-3 yrs.	79-118	34,862,850
Combination Concept	3-5 yrs.	24-40	17,517,720

During construction of relief sewers (Alternatives 1 and 2 and Latenser Plan) or separate storm sewers (Alternative 3), the commercial establishments that are adjacent to construction areas would suffer some financial loss through a reduction in customers. This loss would be most severe where access is temporarily blocked or traffic congestion is heavy. The downtown area would be heavily affected by Alternative 3.

Influence of Alternatives on Water Quality

All of the alternatives except the Latenser Plan, No-Action and Alternative 3 would remove approximately equal amounts of biochemical oxygen demand (BOD_5), suspended solids (SS), total nitrogen (TN) and total phosphorus (TP) from the city's present contribution to the Spokane River. Alternatives 1, 2 and the Klicker Plan would remove approximately 12 to 17 percent of the present city annual average BOD_5 load to the river, less than 1 percent of the total nitrogen and phosphorus load to the river, and 16 to 17 percent of the suspended solids load to the river. The present city load to the river includes combined sewer overflows, main treatment plant discharges and stormwater plant discharges. The Combination Concept would remove slightly larger amounts of BOD_5, TP and TN, but would increase suspended solids discharges due to increased direct stormwater runoff. The Latenser Plan would remove 99 plus percent of the city load of all pollutants by storing CSOs and exporting all city wastewater to the Crab Creek drainage rather than discharging to the Spokane River. This relocates waste-related water quality problems to Crab Creek. Alternative 3 would reduce the city's contribution of BOD_5 by 16 percent, the TN contribution by 22 percent and the TP contribution by 21 percent. Suspended solids loading would be increased by over 160 percent due to direct discharge of stormwater runoff (the SS would be more mineral than organic [waste-related]). The No-Action option would not change city waste contributions to the river. (The data used to estimate these removals were obtained from a variety of sources and were not in all cases presented in comparable parameters. Adjustments were made to the data to make them as consistent as possible and therefore usable in this analysis.)

Only the Latenser Plan would be likely to create significant improvement in water quality in the Spokane River and Long Lake. The other alternatives would probably not remove a sufficient portion of the total pollutant loading (from all sources) to the river and lake to stimulate an obvious change in water quality and eutrophic conditions. This does not include the bacteriological aspect of water quality. The ability of the alternatives to alleviate the bacteria and viral contamination of the Spokane River is discussed as a public health matter in the following section and under Ability of Alternatives to Alleviate Public Health and Aesthetic Concerns in Chapter 4.

None of the alternatives is expected to have a significant direct effect on groundwater quality in the Spokane area, as there is reportedly little subsurface flow from the Spokane River to groundwater in the area downstream from

Spokane and no reports of contamination have been received in the past. However, little groundwater quality monitoring is conducted along the river below Spokane, and in extreme low flow situations the river may recharge the groundwater basin in some locations. Alternative 3 could improve groundwater quality conditions in the Spokane Valley-Rathdrum Prairie aquifer indirectly by allowing eventual sewering of Spokane Valley residences to the Spokane treatment plant. This could eliminate septic tank contamination of this sole-source aquifer.

Ability of Alternatives to Alleviate Public Health and Aesthetic Problems

Two major public health/aesthetic problems are created by the existing combined sewer system in Spokane. First, frequent overflows of combined sewage and stormwater contaminate the river. Second, the combined sewer collection system is too small to carry peak storm runoff in some areas, resulting in local basement and street flooding from backed-up sewers.

The Klicker suboption would best remedy the overflow health hazard by eliminating all overflows. The Alternative 1 option with 25-year storm storage capacity would be nearly as effective. Alternative 3 would eliminate all sewage overflows, but stormwater runoff could still carry chemical contaminants and animal wastes into the river. Alternative 2 would be less effective than any of the above alterantives because CSO's would continue. The primary treatment and chlorination would reduce pathogenic organism levels, but the degree of removal may vary considerably with changes in volume of overflow. Most chemical contaminants would not be removed. The Latenser Plan, the Combination Concept, and the Alternative 1 option with 1-year storm storage capacity would allow one CSO per year. This is a significant reduction from present conditions, but would be less effective than the other alternatives (with the possible exception of Alternative 2). Table 1-3 summarizes the overflow abatement characteristics of the alternatives.

Health hazards and aesthetic problems associated with sewer backups would be most effectively eliminated by new storm sewers (Alternative 3). Practically all backups would be removed. Alternatives 1 and 2 and the Latenser Plan would eliminate most of the problem by constructing 55 miles of relief sewers. These parallel lines would limit backup frequency to about one every 25 years. The Klicker Plan would eliminate backups at those places now experiencing problems by installing on-site check valves. This could simply relocate backup problems in some locations, however, because the sewer trunk system hydraulic overloading is not relieved.

The No-Action option would perpetuate the above mentioned public health/aesthetic concerns.

Table 1-3

FREQUENCY OF OVERFLOW TO SPOKANE RIVER ALLOWED BY CSO ABATEMENT ALTERNATIVES

	Overflows	
	Combined Sewer	Stormwater Only
Alternative 1	1/year or 1/25 years[a]	0
Alternative 2	80-110/year (treated[b])	0
Alternative 3	0	80-110/year
Klicker Plan	0	0
Latenser Plan	1/year	80-110/year (NE Spokane[c])
Combination Concept[d]	1/year	80-110/year
No-Action	80-110/year	0

[a] Number of overflows depends on size of storage basin constructed; each overflow event would theoretically involve discharges from each of the 14 storage basins of Alternative 1.

[b] Alternative 2 would provide primary treatment and chlorination to all overflows prior to discharge to the river.

[c] Latenser proposes new separate storm sewers in a small portion of northeast Spokane.

[d] One CSO per year from those drainage areas served by storage basins and 80-110 stormwater overflows from those drainage areas served by storm sewers.

Long-Term Effect on Beneficial Uses of the Spokane River

The beneficial uses of the Spokane River include a variety of water contact and noncontact activities. The water contact activities (swimming, water skiing, scuba diving, canoeing, kayaking, rafting) would most obviously benefit from a reduction in the overflow-related health hazard. The ability of the alternatives to solve this problem was mentioned above. The Klicker Plan and Alternative 1 (with 25-year storage) are the best at limiting overflows. The noncontact river uses (boating, hunting, fishing, camping, picnicking, hiking, scenic driving, etc.), may be hindered by: waste-related debris on the shoreline, reduced water clarity, algal blooms and proliferation of other aquatic vegetation, and the knowledge that the water is periodically contaminated by CSOs. Currently there is an average of 80 to 110 CSO events each year. This varies from year to year as does the volume of overflow that occurs during a given event. Waste-related debris along the river's shoreline would be eliminated under the Klicker Plan and would be significantly reduced by Alternatives 1 and 2, and the Latenser Plan. The storm overflows allowed to occur under Alternative 3 could perpetuate a debris problem unless additional street cleaning and storm drain cleanup efforts are included as part of the plan. General water clarity would be most improved by adopting the Latenser Plan because nearly all waste-related suspended solids would be removed from the river. It is not known, however, whether waste-related suspended material is a major or minor contributor to the river's total suspended load. There may be no visible improvement with waste removal. The other alternatives are considerably less effective in suspended solids removal. It is unlikely that growth of aquatic vegetation would be significantly altered in the faster flowing reaches of the river. All of the alternatives, with the exception of the Latenser Plan, would remove only a minor portion of the annual nutrient loading to the lower Spokane River. Finally, each of the alternatives should have a very positive influence on the psychological detractions that CSO probably creates for users of the river. At the worst, only one to two overflows of untreated wastewater should occur each year. The Klicker Plan and Alternative 3 would eliminate all sanitary sewage overflows. The other alternatives would be only slightly less effective.

In summary, Alternative 1 (25 year storage), Alternative 3 and the Klicker Plan would probably encourage the greatest water contact use of the river. The Latenser Plan would best reduce nutrient loading to the river and Long Lake. Aesthetics (i.e., turbidity, waste-related debris) would be significantly improved by each of the alternatives.

Cost Considerations

The following tables summarize all cost estimates prepared for the project alternatives. Table 1-4 compares construction, O&M and average annual costs. The average annual cost includes construction cost, engineering and inspection costs and interest during construction, and represents the average annual cost which would be required to construct and operate the project over a period of 20 years. The average annual cost is the value which is used to determine, from a monetary standpoint, the cost-effective alternative. Table 1-5 lists sharing of construction costs by the various government entities. Table 1-6 summarizes estimated user cost increases on either a user charge or ad valorem tax basis.

Energy and Resource Consumption

Energy consumed in wastewater collection, treatment and disposal would be significantly altered by each of the proposed alternatives. Alternative 1 and the Klicker Plan would increase flows through the treatment plant by about 547 million gallons annually. At a consumption rate of 1,562 Kwh of electricity per million gallons treated, energy consumption would jump 854,000 Kwh per year ($8,967 annual power cost increase). Alternative 2 would increase consumption by providing primary treatment to CSOs at the overflow points. No estimate of Kwh required has been made. Alternative 3 would reduce energy consumption by over 6,270,000 Kwh annually due to the elimination of storm flows from the collection and treatment systems (a $65,835 annual cost savings at current electricity rates). The Latenser Plan would increase flows through the plant at nearly the same level as Alternative 1 and the Klicker Plan (854,000 Kwh power increase), and in addition would require a tremendous amount of electricity to pump all of Spokane's wastewater out of the basin to Crab Creek. No estimate of this increase has been prepared, as specific facilities locations have not been determined for the Latenser Plan.

Chemical consumption would also change with each of the alternatives. The increase in flows through the treatment plant resulting from Alternative 1 and the Klicker Plan would increase chemical use proportionately. Approximately $25,800 worth of chemicals would be needed annually for the additional treatment (64,800 lb. ferric chloride, 217,000 lb. quicklime, 305,000 lb. alum and 8,600 lb. chlorine). Alternative 2 would require similar increases, but the polymer and chlorine consumption would occur during primary treatment of overflows at satellite plants rather than from phosphorus removal at the main treatment plant. Alternative 3 would create a large savings in chemicals. Stormwater separation would cut flows to the plant by about 11 million gallons per day on the average or roughly 4,015 million gallons per year. This would result in a savings of over $132,600

Table 1-4

SUMMARY COMPARISON OF ALTERNATIVE COST

	Construction Cost $	O&M Cost $/yr.	Average Annual Cost - $/yr.****
1. City Alternative #1-Storage Basins			
25/yr.* Frequency Storm**	$101,720,000	$771,560	$10,371,660/yr.
1/yr.* Frequency Storm**	53,979,000	771,560	5,878,770
2. City Alternative #2-Satellite Treatment Plants**	95,819,000	474,700	11,401,280
3. City Alternative #3-Storm Sewers	64,050,000	152,930	6,806,510
4. Latenser Export Plan**	105,645,400	587,900	11,085,750
5. Klicker Plan***	60,538,200	837,150	6,568,190
6. Combination Pollution Control and Drainage Concept**	53,084,000	758,450	6,090,940

*Storage basins sized for 25-year-frequency storm is large enough to hold overflows from the heaviest precipitation likely to occur in any 25-year period; 1-year-storm storage capable of holding only the overflows from the heaviest precipitation expected to occur once a year on the average.

**Includes relief sewers to eliminate basement flooding.

***Includes on-site storage tank and check valve at connections which are susceptible to basement flooding.

****Average annual cost comparison was developed following methods used in the city facilities plan (Spokane City Department of Public Works, 1977 Exhibits).

Table 1-5

SUMMARY OF CONSTRUCTION COST SHARING

Alternative	Total Construction Cost	EPA	State of Washington	City of Spokane
1. City Alternative #1-Storage Basins				
1 overflow/25 year*	101,720,000	54,600,000	10,920,000	36,200,000
1 overflow/year*	53,979,000	18,704,250	3,758,850	31,425,900
2. City Alternative #2-Satellite Plants*	95,819,000	50,174,250	10,034,850	35,609,900
3. City Alternative #3-Storm Sewers***	64,050,000	42,170,000	8,430,000	13,450,000
4. Latenser Export Plan*	105,645,400	30,864,300	6,172,860	68,608,240
5. Klicker Plan**	60,538,200	44,653,650	8,930,730	6,953,820
6. Combination Pollution Control and Drainage*	53,084,000	20,373,000	4,074,600	28,636,400

*Includes cost of relief sewers.

**Includes cost of check valves and on-site storage for backup control instead of relief sewers.

***See Proposed Action section of SUMMARY for explanation of Alternative 3 funding allocation.

Table 1-6

SUMMARY OF ESTIMATED INCREASES IN USER CHARGES OR AD VALOREM TAXATION RATES TO FINANCE AND OPERATE THE ALTERNATIVE PROJECTS

	User Charge $/yr/Connection	Ad Valorem Taxation Rates $/1,000 Assessed Valuation
1. City Alternative #1-Storage		
25/yr. Frequency Storm	94.10	2.87
1/yr. Frequency Storm	83.51	2.54
2. City Alternative #2-Satellite Treatment	87.49	2.66
3. City Alternative #3-Storm Sewers	32.59	0.99
4. Latenser Export Plan	162.73	4.96
5. Klicker Plan	30.38	0.93
6. Combination Pollution Control and Drainage Concept	77.09	2.35

in chemical costs. Finally, the Latenser Plan would increase flows through the plant by about 547 million gallons per year but would allow for abandonment of the phosphorus removal process. Alum and ferric chloride use would be eliminated. The net savings in chemical costs would be about $452,700 annually.

Regional Air Quality

None of the CSO facilities plan alternatives would greatly influence air quality in the Spokane area. Some local increases in suspended particulates could be expected in the vicinity of construction areas (especially storage basin sites), but the duration of the increase would be relatively short and could be controlled by proper dust suppression practices. Odor problems could develop around overflow storage basins or satellite treatment plant sites (Alternatives 1 and 2, Klicker Plan, Latenser Plan, Combination Concept), but effects would be localized and relatively infrequent in most cases. The Spokane area is currently classified as an air quality nonattainment area for suspended particulates and carbon monoxide. This indicates federal standards for these pollutants are being exceeded. Local efforts to attain federal air quality standards should not be hindered by any of the proposed alternatives

Effects of Wastewater Importation on the Crab Creek Drainage

The Latenser Plan for CSO control also includes a change in the mode of disposal for Spokane wastewater. The proposed transport of secondary treated wastewater down Crab Creek for irrigation reuse in the Odessa area would have both benefits and detriments. On the benefit side, this plan would provide up to 45,350 acre-feet of water per year to a water-short agricultural area. This could reduce overdrafting of the local groundwater supply and increase the local farmers' crop options. The wastewater would also include an increment of nitrogen and phosphorus with fertilizer value.

On the negative side, the wastewater discharge into Crab Creek could violate Class B stream water quality standards established by the Washington DOE. Aesthetic and toxic and deleterious materials standards are the greatest concern. The state's advanced waste treatment policy which requires 20 to 1 instream dilution of all new surface water discharges could also be violated in the dry season. In addition, the high ratio of effluent to natural stream flows would raise public health concerns for water contact recreationists in low flow periods. Dissolved oxygen sags might also be stimulated during low stream flows; this would be deleterious to the stream's fish population. The wastewater would be chlorinated, but local public health officials have voiced reservations about using Crab Creek for wastewater transport. Finally, increased irrigation on the Odessa area's rolling, silt loam soils could increase soil erosion substantially without proper management practices.

Regionalization of Wastewater Treatment

In order to supply wastewater service to outlying county areas, the City of Spokane must reduce stormwater flows in its overloaded interceptor system and treatment plant. This removal is best accomplished by Alternative 3, which separates stormwater from the sanitary wastewater interceptor system. The storage alternatives (Alternative 1, Klicker Plan, Latenser Plan) can reduce stormwater peak flows, but they cannot readily supply sufficient storage to allow eventual conversion of the plant's stormwater clarifiers to secondary clarifiers, a change that must occur to increase the plant's secondary treatment capacity sufficiently to accommodate flows from large county annexation.

Once all stormwater separation is completed under Alternative 3 (estimated at 8 to 10 years) there would be approximately 11 million gallons per day (mgd) of additional capacity available in the Spokane treatment plant. By 1990, the treatment plant would be able to accommodate the anticipated flows from the City of Spokane (32.39 mgd average dry weather flows [ADWF]) and North Spokane (3.91 mgd ADWF) with little or no treatment plant modification. With conversion of the plant's stormwater clarifiers, and other minor plant modifications, the two areas could be served beyond the projects' 20-year planning period. If Spokane Valley were to tie into the city system after sewer separation, the stormwater clarifier conversion would be necessary prior to 1990, but the expanded plant capacity would still serve both areas beyond the 20-year planning period. Other combinations of regionalization are analyzed in Chapter 4 of this report.

Proposed Action

As a result of this report's economic and environmental analyses, EPA has selected an apparent best project alternative for consideration by the City of Spokane, concerned government agencies and the public in general. This proposed action is a phased implementation of Alternative 3. The first phase project is the basis for EPA's anticipated funding participation and includes construction of separate storm sewers in the drainage areas contributing to the Meenach and Hollywood overflow points (Figure 5-1). Separation of stormwater in these two drainage areas would remove approximately 84 percent of the CSO that now flows into the Spokane River each year. This can be accomplished for approximately 39 percent of the total construction cost of Alternative 3. The second phase of the proposed action would provide separate storm sewers for the remainder of the City of Spokane.

A high level of federal and state funding for Phase 1 was estimated assuming Phase 2 would eventually be completed. Phase 2 would reduce stormwater flows to the Spokane plant sufficiently to allow it to function as a regional wastewater facility. Phase 1 was given a sizable cost credit on the basis that it would be a first step in efforts to make the Spokane plant a regional treatment plant, a regionalization which would produce a substantial cost savings for wastewater treatment for the Spokane Valley as well as providing additional protection for the sole-source aquifer. A necessary second step, however, would be the construction of the Phase 2 facilities. Construction cost sharing for the propcsed action is summarized below.

	Total Construction Cost		Cost Sharing	
			State of Washington	City of Spokane
Phase 1	$24,980,000	$18,740,000	$3,750,000	$2,490,000
Phase 2*	$39,070,000	$23,430,000	$4,680,000	$10,960,000

*Allocation assumes a level of EPA and state participation which has not been officially established to date (see Chapter 5).

The impacts of the proposed action would be essentially the same as those described for Alternative 3; the only difference would be that the second part of the sewer separation would probably occur at a later date than anticipated for Alternative 3. Development of Phase 2 implementation timetables, construction priorities and sources of funding would occur sometime during or after Phase 1 implementation.

The Phase 1 project would eliminate 84 percent of Spokane's CSO, but would probably not result in a discernible change in Spokane River water quality. Approximately 3 percent of the city's total nitrogen input and 5 percent of its total phosphorus input to the river would be removed. Public health hazards downstream from the City of Spokane would be significantly reduced even though periodic CSOs from approximately 25 discharge points would continue. The two largest sources of untreated wastewater would be eliminated. The sewer backup problem would be solved for most of the northern 1/3 of the city, but the areas with apparently the most severe problems (the north central and southern regions) would not be relieved. On an annual basis, the Phase 1 separation should reduce flows into the treatment plant by about 595 million gallons. While this would relieve some of the current load on the plant, it would not be sufficient to allow annexation of flows from a sizeable outlying area such as North Spokane or Spokane Valley. The inability of Phase 1 to meet the project's water quality, sewer backup and regionalization objectives emphasizes the importance of continuing with Phase 2.

The proposed action provides the city with the second least costly CSO control option (assuming federal and state funding of Phase 2 as indicated in Chapter 5). The city's increment of Phase 1 construction cost would be $2,490,000. The annual operation and maintenance cost of the new facilities would be $67,620 and the average annual total cost to the city would be about $377,000. If the local share was financed through user cost increases, the annual user cost to a residential unit would increase by about $6.23 (18 percent increase). If paid for by ad valorem tax increases, the current property tax rate of 18.961 would increase by about .21 percent (1 percent increase). The incremental increase with Phase 2 is discussed in Chapter 5.

Agencies Involved/Public Participation

The U. S. Environmental Protection Agency has prepared this EIS to satisfy the mandates of NEPA and involve the Spokane area public in the facilities planning process. The study has been closely coordinated with the Spokane City Utilities Department and Department of Public Works, as well as the Washington Department of Ecology. Numerous other federal, state, regional and local agencies have been consulted in the process so that all significant environmental issues could be identified. Public participation has also been strongly encouraged. Two invited workshops were held in Spokane (July 25 and October 25, 1978) to discuss the progress of the EIS and solicit the suggestions and concerns of agencies and individuals that have shown a continuing interest in the CSO abatement project. This Draft EIS is receiving wide public distribution to receive public comment. Approximately 30 days after its release, a public hearing will be held to receive oral and written comments. Comments can also be mailed to the Environmental Review Branch, Mail Stop 443, Environmental Protection Agency, Region X, Seattle, Washington. Following the hearing and the 45-day public comment period, a Final EIS will be prepared, addressing all pertinent questions raised.

Report Organization

The remainder of the EIS is divided into five major parts. The description of existing and proposed wastewater facilities follows in the next chapter. A listing of legal and regulatory influences on the proposed project is included in Chapter 3 and the impact discussions are included in Chapter 4. Chapter 5 describes the proposed CSO abatement action detail and discusses its impacts. Chapter 6 presents a brief description of existing environmental conditions in and around the Spokane area. Finally, supporting material including bibliography, appendices, and lists of individuals and agencies contacted in preparation of the report are attached at the back. Tables and figures referred to in the text but included in the appendices are given the appendix letter designation followed by a number (i.e., Table A-1, is the first table in Appendix A).

Chapter 2

EXISTING AND PROPOSED ALTERNATIVE FACILITIES

Existing Sewerage Facilities

Overview of Regional Wastewater Systems

When the City of Spokane's wastewater treatment plant was designed and constructed, the long-term planning was for the plant to ultimately become a regional plant to serve not only the City of Spokane, but also North Spokane and much of the Spokane Valley. Although the plant was not constructed large enough during the most recent construction to serve the contiguous county areas, the site layout has been planned for ultimate expansion to serve these areas.

The principal advantage of a regional plant is the economy of scale which characteristically results from the construction and operation of one large plant rather than several smaller plants. In many situations, however, the need for long interceptors to the regional plant can eliminate the saving which results from construction and operation of a large regional facility. An additional advantage of regionalization at the existing plant is the ability to discharge to the Spokane River and avoid a discharge to the sole-source aquifer. A discharge to the aquifer would require a higher level of treatment than required for a river discharge at a resultant higher cost. At the present time, several engineering studies are underway to determine whether it would be cost-effective for the adjacent county areas to discharge their wastewater into the City of Spokane's system. Kennedy Engineers, Inc. (1978a) are considering use of the Spokane plant for treatment of wastewater from the north Spokane area. URS Company (1978) is revising data presented in the U. S. Army Corps of Engineers (1976) Metropolitan Spokane Report that deal with treating Spokane Valley wastewater at the Spokane plant. Recently the Spokane County engineers submitted a plan of study to DOE that would take a further look at regionalization possibilities for all county urban areas adjacent to the City of Spokane. This would in effect be a regional 201 facilities plan.

Interestingly, the decision on the use of storage basins vs. storm sewers will have a strong influence upon whether it is cost-effective for outlying areas to convey wastewater to the city's plant. If storm sewers are constructed a substantial amount of wastewater interceptor capacity would be made available, thus reducing the cost of conveying

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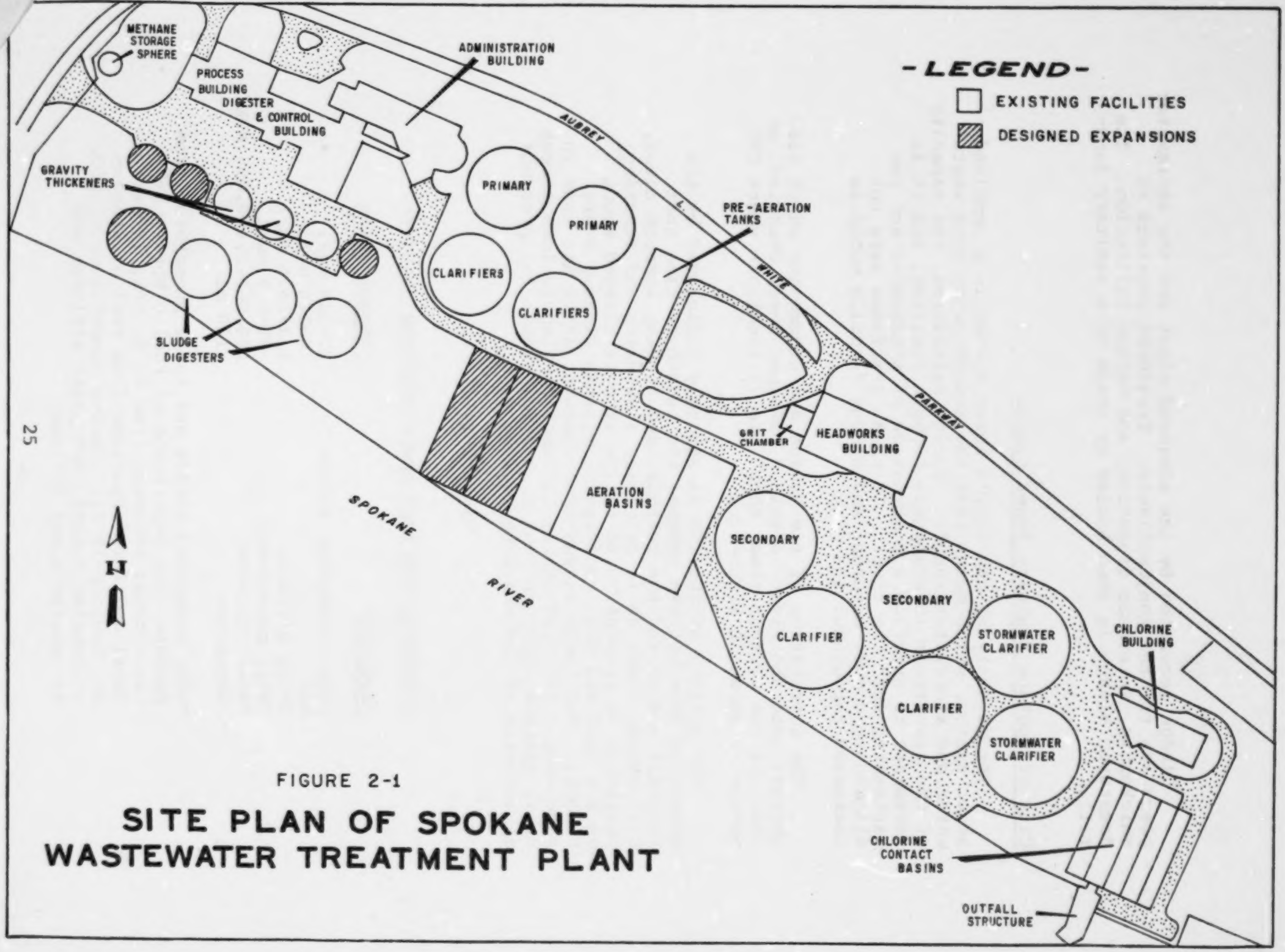
wastewater from outlying areas to the city's plant. If storage basins are constructed, both treatment and interceptor capacity will be limited, and costs for outlying county areas may be higher than if storm sewers were constructed.

City of Spokane Wastewater Treatment Plant

The city's existing advanced wastewater treatment plant is located on the north bank of the Spokane River, just below the Downriver Municipal Golf Course. Practically speaking, there are two plants at the site, one an advanced wastewater treatment plant and the second, a stormwater treatment plant, which provides primary treatment and disinfection for peak wet weather flows exceeding the capacity of the advanced treatment plant. The average daily flow capacity of the advanced plant is 40 mgd, although during peak stormwater conditions, 77 mgd can be passed through the secondary plant. The present average daily flow through the advanced plant is about 39 mgd, although it is estimated that only about 28 mgd is due to domestic wastewater, and the remainder is stormwater. The capacity of the stormwater plant is 69 mgd, but the stormwater plant is normally only utilized when 77 mgd of peak flow is being passed through the advanced plant.

A plot plan for the treatment complex is shown in Figure 2-1. The plant has been laid out on the site to allow for future expansion from 40 to 60 mgd. The timing for any expansion is highly dependent upon whether outlying areas join with the city. If no outlying areas chose to participate with the city, the plant capacity would be adequate beyond the project 20-year planning period (1980-2000); assuming stormwater separation; for further capacity discussion see Influence of CSO Alternatives on the Spokane Wastewater Treatment Plant Capacity and Long-Term Viability in Chapter 4).

Flow passing through the advanced treatment plant receives screening and grit removal, primary treatment, activiated sludge secondary treatment, phosphorus removal and disinfection. Phosphorus removal is achieved by the addition of alum (or ferric chloride) in conjunction with polymer, prior to secondary clarification. The phosphorus removal then occurs by precipitation within the secondary clarifier. Phosphorus removal by this method is substantially less expensive than use of a separate treatment process after secondary treatment. Flow which is passed through the stormwater plant receives screening and grit removal, primary sedimentation, and disinfection. Discharge from both plants is directly to the river at the plant site.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☐ EXISTING FACILITIES
▨ DESIGNED EXPANSIONS
METHANE STORAGE SPHERE
PROCESS BUILDING
DIGESTER & CONTROL BUILDING
ADMINISTRATION BUILDING
GRAVITY THICKENERS
SLUDGE DIGESTERS
PRIMARY
PRIMARY
CLARIFIERS
CLARIFIERS
AUBREY L. WHITE PARKWAY
PRE-AERATION TANKS
GRIT CHAMBER
HEADWORKS BUILDING
AERATION BASINS
SPOKANE RIVER
SECONDARY
SECONDARY
CLARIFIER
CLARIFIER
STORMWATER CLARIFIER
STORMWATER CLARIFIER
CHLORINE BUILDING
CHLORINE CONTACT BASINS
OUTFALL STRUCTURE
N

FIGURE 2-1

SITE PLAN OF SPOKANE
WASTEWATER TREATMENT PLANT

Sludge generated by the advanced plant and the stormwater plant are treated conjunctively. Treatment consists of thickening, anaerobic digestion, and vacuum filtration. The dewatered sludge is then hauled by truck to a sanitary landfill.

City of Spokane Sanitary Sewer System

The majority of the city's sewer system is a combined sewer system, which means that the sewers carry both wastewater and stormwater runoff. During rainstorms, the capacity of the downstream interceptors becomes limiting, and it is necessary to overflow a combination of stormwater and raw wastewater into the river. If these overflows were not allowed to occur, basement and street flooding would be increased throughout the city.

The combination of raw sewage and stormwater which discharges into the river is called Combined Sewer Overflow, or CSO. At the present time, there are 28 locations where CSO occurs as shown on Figure 2-2.

The quality of the CSO is strongly influenced by the length of time between storms, the length of time that rainfall occurs and the methods used to keep streets clean. City street cleaning is primarily a sweeping and flushing operation at present, with busier streets cleaned about once a week and most residential streets cleaned every 6 weeks. Two large vacuum-type cleaning units are used in some areas, but most debris is swept or flushed into street drain systems under current practices. Table 2-1 presents an estimate of CSO characteristics.

Table 2-1

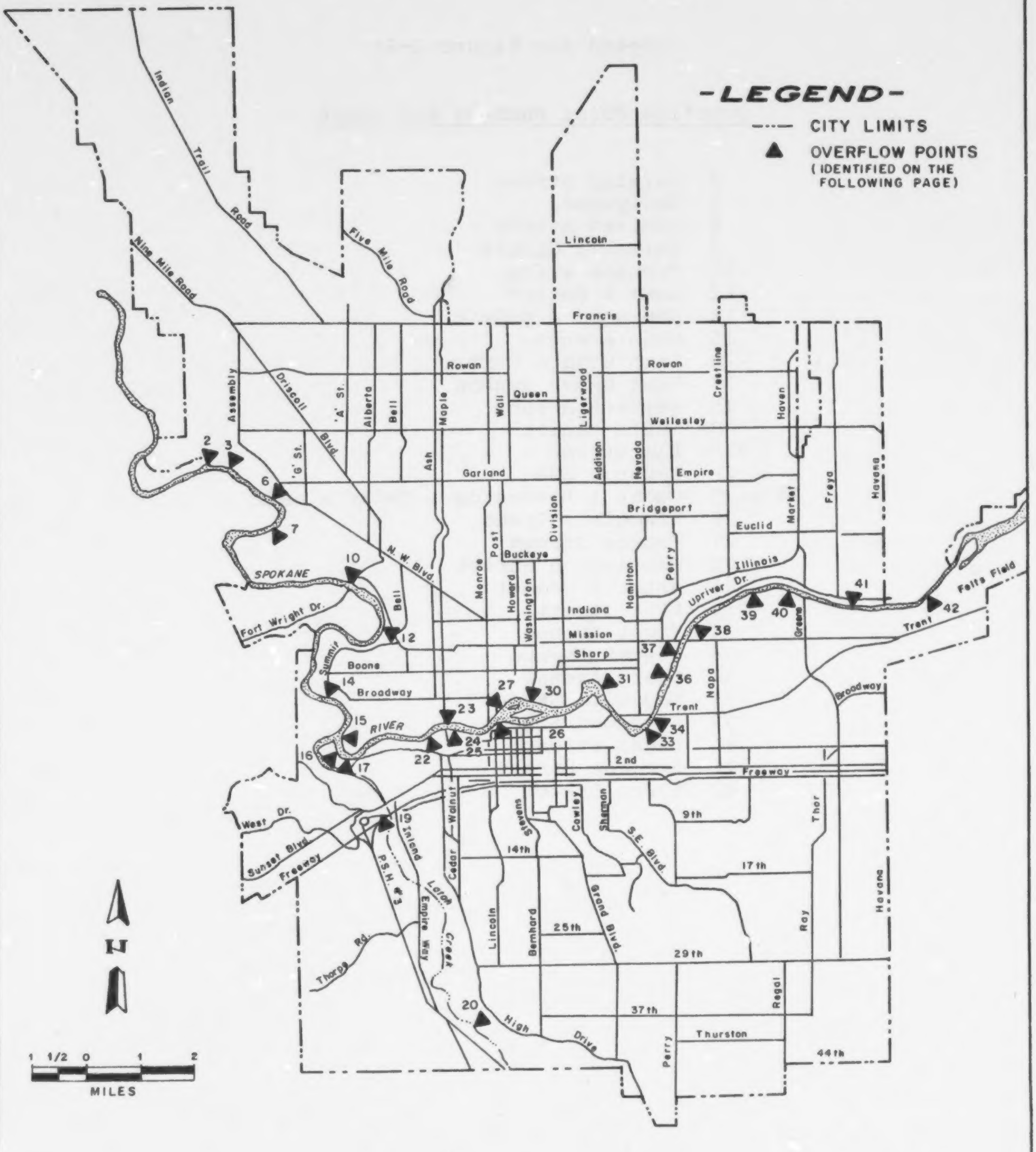
ESTIMATED COMBINED SEWER OVERFLOW QUALITY*

Parameter	Concentration
Total suspended solids	20-210 mg/l
BOD	76-220 mg/l
Total nitrogen	4.3-16.6 mg/l
Total phosphorus	.95-1.9 mg/l
Fecal coliform organisms	100,000-2,400,000 MPN/ 100 ml

*BOD, suspended solids and total phosphorus from Spokane City Department of Public Works, 1977, text; total nitrogen from U. S. EPA, 1977a; fecal coliform organisms from various sources. See Table B-10 for quality comparisons of CSO, stormwater runoff, AWT plant effluent and stormwater plant effluent.

FIGURE 2-2

COMBINED SEWER OVERFLOW POINTS


-LEGEND-
CITY LIMITS
OVERFLOW POINTS (IDENTIFIED ON THE FOLLOWING PAGE)
Indian Trail Road
Nine Mile Road
Five Mile Road
Lincoln
Francis
Rowan
Queen
Wellesley
Garland
Empire
Bridgeport
Euclid
Buckeye
Illinois
Upriver Dr.
Indiana
Mission
Sharp
Boone
Broadway
Trent
2nd
Freeway
9th
14th
17th
25th
29th
37th
Thurston
44th
High Drive
Felts Field
SPOKANE RIVER
Fort Wright Dr.
West Dr.
Sunset Blvd
Thorpe Rd.
Empire Way
Latah Creek
P.S.H. #3
Inland
S.E. Blvd.
Grand Blvd.
Assembly
Driscoll Blvd.
'G' St.
'A' St.
Alberta
Bell
Ash
Maple
Wall
Ligerwood
Addison
Nevada
Crestline
Haven
Havana
Freya
Market
Napa
Greene
Perry
Hamilton
Division
Post
Monroe
Howard
Washington
N. W. Blvd.
Summit
Cedar
Walnut
Stevens
Cowley
Sherman
Lincoln
Bernhard
Regal
Ray
Thor
2
3
6
7
10
12
14
15
16
17
19
20
22
23
24
25
26
27
30
31
33
34
36
37
38
39
40
41
42
N
1 1/2 0 1 2
MILES

SOURCE: MODIFIED FROM SPOKANE CITY DEPARTMENT OF PUBLIC WORKS, 1977, EXHIBITS

(Legend for Figure 2-2)

Overflow Point Numbers and Names

2	Hartley Street
3	Hollywood
6	Garland Avenue
7	Columbia Circle
10	Meenach Drive
12	Nora & Pettet
14	Sherwood & Summit
15	Ohio Avenue
16	High Bridge Park
17	West Grove Syphon
19	Seventh Avenue
20	South Manito
22B	Elm Street
23	Cedar & Ide
24 & 25	Cedar & Riverside & Cedar & Main
26	Lincoln & Trent
27	Monroe Street
30	Washington Street
31	Astor & Desmet
33	Erie Street
34	Front Avenue
36	Desmet Avenue
37	Sharp Avenue
38	Magnolia Street
39	Altamont Street
40	Regal Street
41	Rebecca Street
42	Surro Drive

It should be emphasized that sample values may be significantly higher than shown in Table 2-1 if a rainfall has not occurred for a significant length of time or the rainfall has just begun and runoff is just beginning to occur. The estimated annual CSO flow to the Spokane River through the overflow points is 547,100,000 gallons.

The principal concern relating to CSO is its impact on beneficial uses of the Spokane River. The constituents in the CSO which are of particular importance are pathogenic organisms and solid materials of sewage origin. Also of concern are nutrients including nitrogen and phosphorus, which contribute to downstream algal growth.

Alternative CSO Facilities

Introduction

The principal objectives of this project are: (1) to protect the downstream beneficial uses of the river by removing CSO; (2) to eliminate basement flooding due to sewer backups and to eliminate other drainage problems which occur when the sewers flow full during storms; and (3) to maintain as a future option the ability to use the existing wastewater treatment plant as a regional facility. The three basic CSO control measures which are considered in this EIS are:

a) Storage of potential overflow, with subsequent treatment
b) Satellite treatment of overflow
c) Storm sewers to separate domestic wastewater from stormwater

Storage is accomplished using either underground or open basins. Overflow from the storage basin can still occur, however, with the amount of overflow depending on the size of the storage basin. When the storm has passed and the flow in the interceptors to the treatment plant begins to decrease, the stored wastewater/stormwater is allowed to gradually flow back into the interceptor for subsequent treatment and discharge. Therefore, all water which is retained in the basin will receive the same treatment as sewage. This could be primary or secondary treatment, depending upon the flow rate into the plant at the time the stored water is fed back into the main interceptor. The major design decisions required for storage basins are whether the basins should be open or covered, how many storage basins should there be, and for what frequency of storm should the basins be designed.

Satellite treatment plants are small plants located at the point of overflow which treat CSO before it is discharged to the river. The treatment provided removes floating and screenable material, plus much of the suspended solids and BOD. Disinfection is also provided for the destruction of coliform organisms. The satellite treatment plants are principally below ground, although some structural concrete would be several feet out of the ground. The plants would not be housed although there will be a small operations building required at each site.

Storm sewers allow storm runoff to be conveyed separately from sanitary wastewater. When the stormwater is removed from the existing combined sewers, sufficient capacity is available to carry wastewater even during storms. CSO is thereby eliminated, and the only discharge to the river is the discharge from the storm sewers. This option also remedies existing sewer backup and flooding problems.

Basement flooding occurs during storms when combined sewers become full, and a combination of storm water and sanitary wastewater from the sewer back up into the basements of homes located at lower elevations. Storm sewers eliminate this problem because they remove the storm flow from the existing combined sewers. Conversely, the storage basins and satellite treatment do not eliminate basement flooding unless relief sewers or individual on-site control structures are constructed. Relief sewers would be constructed parallel to the existing combined sewers to provide additional flow capacity. Frequent interconnections would be used between the new relief sewers and the existing combined sewers. Generally, relief sewers are needed only in areas where the combined sewers have inadequate capacity for the combined stormwater and wastewater. In the Facilities Plan (Spokane City Department of Public Works, 1977), the relief sewers were sized to handle a 25-year frequency storm. The construction cost of relief sewers is estimated to be $28,920,000 with an annual O&M cost of $38,500. The cost of relief sewers must be added to the cost of any storage or satellite treatment concept, if basement flooding and other drainage problems are to be eliminated.

City Alternative 1 - Storage Basins

Storage Plans A, B, and C. The storage basin option uses covered underground concrete basins to store the CSO flow which would otherwise overflow to the Spokane River during the peak runoff period. Then, when the storm water runoff decreases, the stored wastewater and runoff would gradually be added back into the interceptor sewers and conveyed to the treatment plant for treatment and discharge. This store and trickle procedure does not eliminate the use of the stormwater primary clarifiers and does not guarantee that all stored overflows will eventually receive full advanced treatment. During extended rainy periods, some of the stored water may actually be fed through the stormwater primary treatment system.

In the City of Spokane's Facilities Planning Report for Sewer Overflow Abatement, (Spokane City Department of Public Works, 1977), three different storage concepts were presented and referred to as Plans A, B, and C. The difference between these plans is in the number of storage basins which could be utilized. Plan A uses 24 basins, Plan B uses 15 basins, and Plan C uses 10 separate storage basins. A cost and environmental analysis was conducted to determine which plan was the least costly concept, and Plan B was determined to be the best.

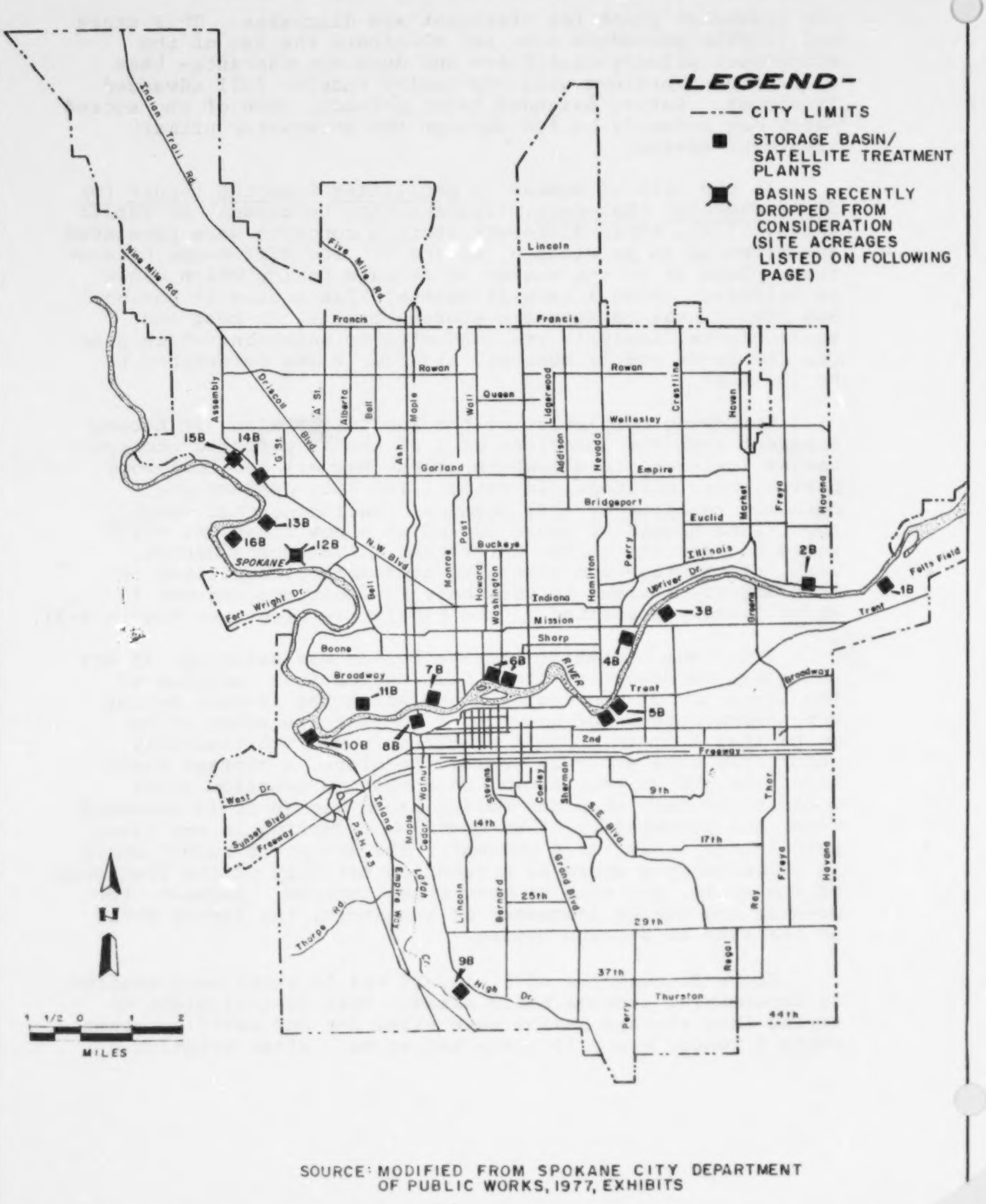
Following completion of the Facilities Plan, it became apparent that the locations of 2 of the 15 proposed storage basins (referred to elsewhere as the Meenach and Hollywood basins) were not feasible sites. The city conducted a detailed analysis of this problem, concluding that these two basins should be consolidated at a new location, which would be adjacent to the Rivercrest Convalescent Center. Thus, all storage and satellite treatment alternatives in this EIS are assumed to have only 14 locations and not 15 as originally described in the Facilities Plan (see Figure 2-3).

After the number of storage basins was selected, it was necessary to determine their size, which is a function of the frequency of the design storm which the storage basins can accommodate. For example, a 25-year frequency storm means that a storm of that magnitude would statistically occur only once every 25 years; therefore, a storage basin sized for the 25 year storm means that an overflow event could occur only when the design storm occurs or is exceeded. Thus, the probability of an overflow occurring in any given year is one in 25, or 4 percent. The amount of runoff which is produced by a storm is a function not only of the frequency of the storm, but also of many other factors. However, the greater the design frequency of the storm, the larger would be the size of storage basins.

Storm frequencies of 5, 10, 25 and 50 years were studied in determining storage basin sizes. This is equivalent to saying that storage basins were sized for one overflow event every 5 years, every 10 years and so on. After weighing all

FIGURE 2-3

STORAGE BASIN/SATELLITE TREATMENT PLANT SITES FOR ALTERNATIVES 1&2


-LEGEND-
CITY LIMITS
STORAGE BASIN/ SATELLITE TREATMENT PLANTS
BASINS RECENTLY DROPPED FROM CONSIDERATION (SITE ACREAGES LISTED ON FOLLOWING PAGE)
1B
2B
3B
4B
5B
6B
7B
8B
9B
10B
11B
12B
13B
14B
15B
16B
SPOKANE
RIVER
Indian Trail Rd
Nine Mile Rd
Five Mile Rd
Lincoln
Francis
Rowan
Queen
Wellesley
Garland
Empire
Bridgeport
Euclid
Buckeye
Illinois
Upriver Dr.
Indiana
Mission
Sharp
Boone
Broadway
Trent
2nd
Freeway
9th
14th
17th
25th
29th
37th
Thurston
44th
High Dr.
Falls Field
Assembly
Driscoll Blvd
'G' St.
'A' St.
Alberta
Bell
Ash
Maple
Wall
Ldgerwood
Addison
Nevada
Crestline
Haven
Market
Freya
Havana
N.W. Blvd
Fort Wright Dr.
Post
Monroe
Howard
Washington
Hamilton
Perry
Greene
West Dr.
Sunset Blvd
Inland
P.S.H. #3
Walnut
Cedar
Latah
Empire Way
Stevens
Cowley
Sherman
S.E. Blvd
Grand Blvd
Bernard
Thor
Ray
Regal
Thorpe Rd
N
MILES
1
1/2
0
1
2

SOURCE: MODIFIED FROM SPOKANE CITY DEPARTMENT OF PUBLIC WORKS, 1977, EXHIBITS

Size of Proposed Storage Basins/Satellite Plants*
(in acres)

Site No.	Storage Basin**	Satellite Plant**
1B	.10	.06
2B	.15	.09
3B	.25	.15
4B	.20	.14
5B	5.60	1.55
6B	2.50	.35
7B	.41	.23
8B	5.50	2.30
9B	.82	.23
10B	.61	.25
11B	.25	.20
12B***	10.50	2.60
13B	.20	.14
14B	1.00	.38
15B***	1.90	.60
16B	12.40	3.20

* Source: Gellner, pers. comm.
**25-year storm design basis.
*** Recently eliminated from consideration; replaced by 16B.

factors, the city selected the 25-year frequency for the design storm, because they felt it offered the best balance between project cost and protection of the environment. The estimated construction cost for the storage basins sized for a 25-year-frequency storm is $72,800,000 with an annual operation and maintenance cost of $733,110. Addition of relief sewer costs to the storage basin costs results in a construction cost of $101,720,000 and an annual operation and maintenance cost of $771,560.

After review of the city's Facilities Plan by the EPA, the EPA requested that additional analyses be conducted to determine whether the 25-year storm was the most reasonable to use for the design of storage basins. The results of the city's reevaluation were that storage basins should be sized to allow one overflow per year. This decision was based on a comparison of monetary costs of alternative capacities with basin effectiveness in terms of CSO volumes controlled and expected number of overflows per year. The estimated construction cost for storage basins sized for one overflow event per year is $25,059,000, with an annual maintenance cost of $733,110. Addition of relief sewer costs increases the construction cost to $53,979,000 and the annual operation and maintenance cost to $771,560.

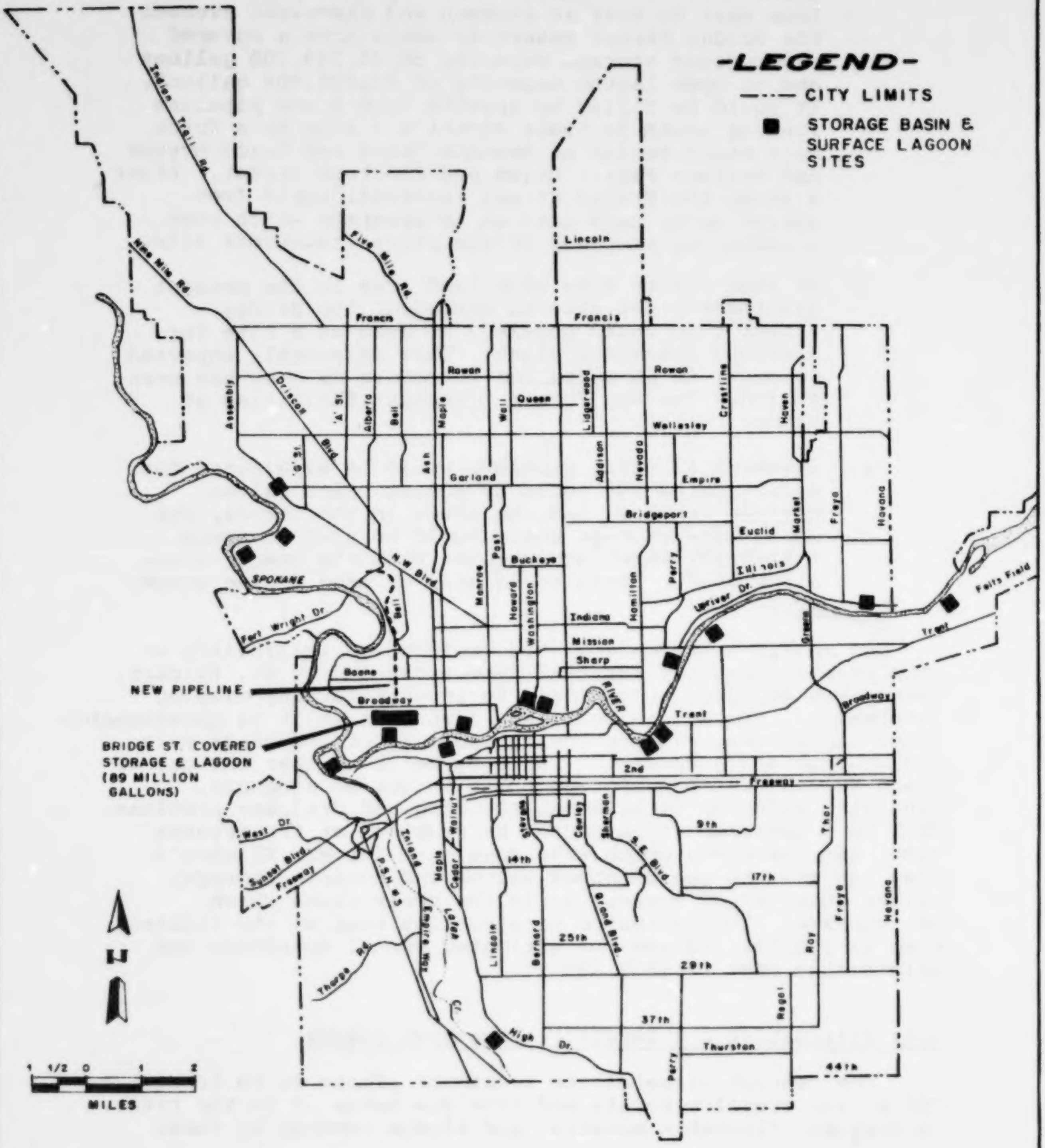
Klicker Storage Suboption. This plan was developed by a private citizen, Mr. Jake Klicker. The plan is essentially one of storage, with gradual feedback to interceptors when the stormwater flow subsides. Although similar to the storage concept in the Facilities Plan, the Klicker Plan differs because it uses a combination of covered underground and open surface storage basins. The open lagoon would be located adjacent to the underground basins, and CSO would flow into the open, earthen-constructed storage basins when the underground basins are full. The total storage volume provided would be sufficient to eliminate all overflow to the river. The basic features of the Klicker Plan are:

1. At each of the 14 storage locations in the Facilities Plan (Plan B), a covered underground storage basin would be constructed. The storage basins would be sized to allow one overflow event every 5 years. When the overflow occurs, it would be into the open storage lagoons located adjacent to the underground basins, rather than into the river.

2. In addition to the 14 storage basins, a large basin/lagoon would be located on the north bank of the Spokane River, generally between Bridge Street and Maple Street (Figure 2-4). This Bridge Street reservoir essentially replaces the basin the city had designed to service the Meenach overflow (Basin 12B in Figure 2-3). It would be used to

FIGURE 2-4

KLICKER PLAN FACILITIES


-LEGEND-
CITY LIMITS
STORAGE BASIN & SURFACE LAGOON SITES
NEW PIPELINE
BRIDGE ST. COVERED STORAGE & LAGOON (89 MILLION GALLONS)
SPOKANE
RIVER
Indian Trail Rd
Nine Mile Rd
Five Mile Rd
Lincoln
Francis
Rowan
Queen
Wellesley
Assembly
Driscoll Blvd
'A' St
'G' St
Alberta
Bell
Ash
Maple
Wall
Lidgerwood
Crestline
Haven
Garland
Addison
Nevada
Empire
Bridgeport
Euclid
Market
Freya
Havana
Buckeye
Illinois
Perry
Hamilton
Monroe
Post
Howard
Washington
Indiana
Mission
Sharp
Upriver Dr.
Greene
Felts Field
Trent
N.W. Blvd
Fort Wright Dr.
Boone
Broadway
2nd
Freeway
9th
14th
17th
25th
29th
37th
44th
Thurston
Regal
Ray
Thor
West Dr.
Sunset Blvd.
PSH #3
Inland
Walnut
Cedar
Stevens
Cowley
Sherman
S.E. Blvd
Grand Blvd.
Bernard
Latah
Empire Way
Thorpe Rd
High Dr.
1 1/2 0 1 2
MILES

SOURCE: MODIFIED FROM SPOKANE CITY DEPARTMENT OF PUBLIC WORKS, 1977, EXHIBITS

store flow from a major interceptor which runs from east to west in Jackson and Cleveland Avenues. The Bridge Street reservoir would have a covered underground storage capacity of 45,240,000 gallons and an open lagoon capacity of 43,720,000 gallons. It would be filled by gravity from a new pipeline running south in Cedar Street and also by a force main which begins at Meenach Drive and Grace Avenue and follows Pettit Drive and Chestnut Street. After a storm the Bridge Street reservoir would feed stored water back into an interceptor which runs beneath the proposed Bridge Street reservoir site.

At some future time when land area at the present treatment plant site is exceeded, the Bridge Street site could possibly be used as a site for a second treatment plant. This is roughly expected to occur in 50 years and therefore no cost has been included for any future treatment facilities at Bridge Street.

3. Basement flooding problems would be eliminated for an estimated 700 homes by adding check valves between the home and the sewer in the street, and small home storage units would be used to store wastewater which accumulates when the check valves are closed. These would only be used during storm conditions.

An analysis was made of the engineering feasibility of this proposal and the cost estimate presented by Mr. Klicker. Costs were adjusted accordingly to account for any missing components. The most significant component which is questionable about the Klicker Plan is the reliability of the check valve and storage basin concept. The city believes that the use of check valves and home storage units is not an adequate, long-term solution to basement flooding and drainage problems. This is a question which cannot be resolved at the present time, and the costs which were developed for Mr. Klicker's plan include the use of check valves and on-site storage, rather than relief sewers, as in the other plans which use storage. The estimated construction cost of the Klicker Plan is $60,538,200 and the estimated annual operation and maintenance cost is $837,150.

City Alternative 2 - Satellite Treatment Plants

The concept of satellite treatment plants is to treat CSO at the overflow points and then discharge it to the river. Screenings, floatable material and sludge removed by these satellite plants would be discharged back into the interceptor and carried to the treatment plant for disposal. As in the storage basin concept, Plans A, B, and C were developed, which are equivalent to 24, 15 and 10 locations for treatment, respectively. The Facilities Plan determined Plan B to be the best plan, with the satellite treatment plants sized to handle the 25-year-frequency storm. Similarly, to the storage basin concept being revised from 15 to 14 locations, only 14 satellite plants would be utilized, with locations as shown in Figure 2-3.

The estimated construction cost would be $95,819,000 with an annual operation and maintenance cost of $474,700 per year.

City Alternative 3 - Separate Storm Sewers

At the present time most of the city has combined storm sewers and drainage in these areas is handled by the existing combined sewer system. There are only 57 miles of separate storm sewers. The project proposed by Alternative 3 is the construction of 220 miles of separate storm sewers. The new storm sewers would be designed for a 5-year-frequency storm, which is the same design criteria as the existing storm sewers. The storm sewers would discharge directly into the Spokane River.

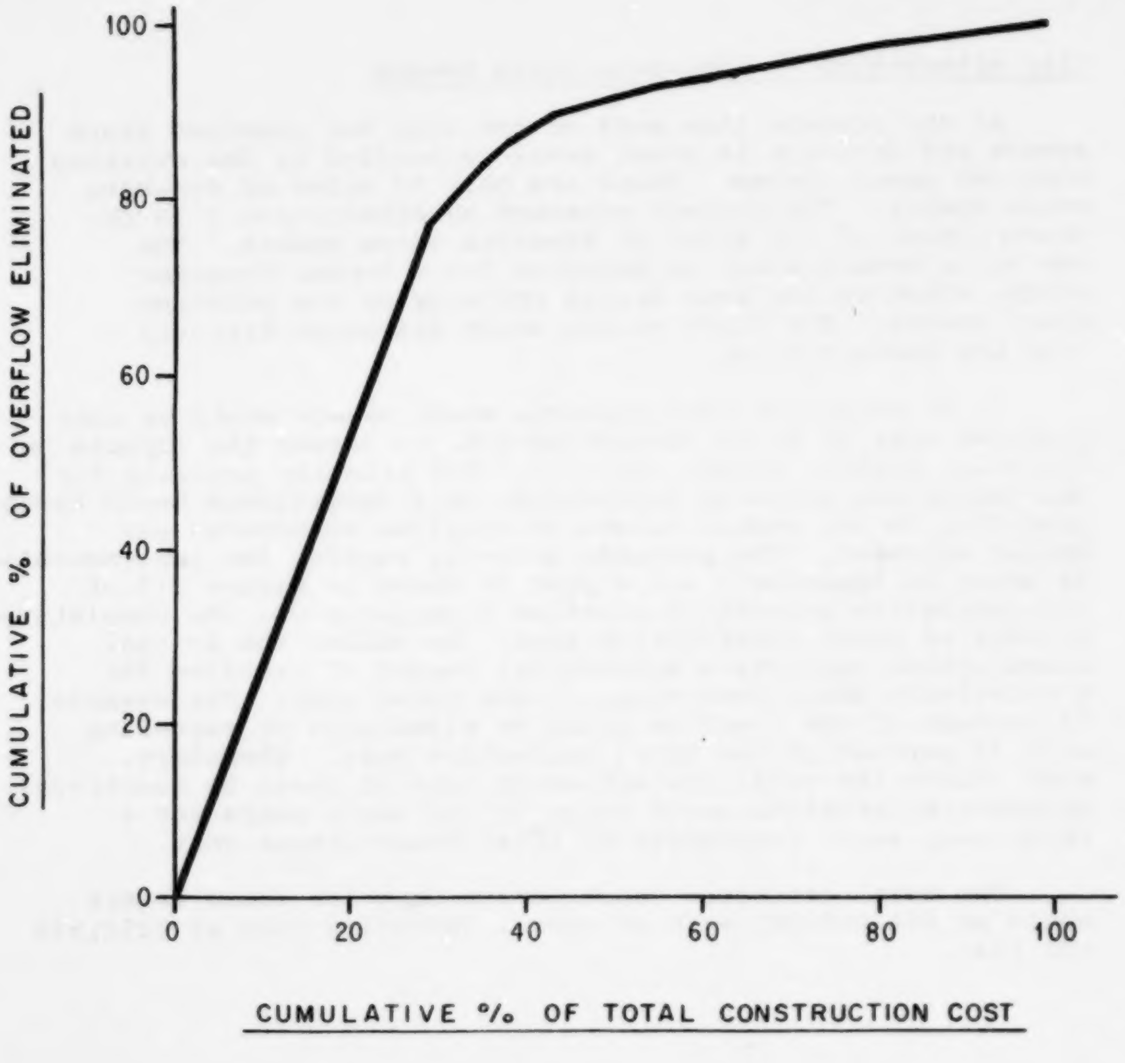
It is estimated that separate storm sewers would be constructed over an 8- to 10-year period, to lessen the impacts on vehicular traffic within the city. The priority schedule for implementation would be determined, on a subdrainage basin basis, according to the annual volume of overflow eliminated per dollar expended. The probable priority ranking for implementation is shown in Appendix C and a plot is shown in Figure 2-5 of the cumulative percent of overflow eliminated vs. the cumulative percent of total construction cost. As shown, the initial construction corrects a substantial amount of overflow for a relatively small percentage of the total cost. For example, 84 percent of the overflow could be eliminated by expending only 39 percent of the total correction cost. Therefore, even though the total project would take 10 years to construct, substantial benefits would occur in the early years for a relatively small percentage of total construction cost.

The total estimated construction cost for storm sewers would be $64,050,000 with an annual operating cost of $152,930 per year.

FIGURE 2-5

STORM SEWERS

CUMULATIVE % OVERFLOW* ELIMINATED VS CUMULATIVE % OF CONSTRUCTION COST EXPENDED



*OVERFLOW CONSIDERED ON A VOLUME BASIS

Best Management Practices (BMP) to improve the quality of urban stormwater runoff should be an integral part of this alternative. It is possible for BMPs to be required in the NPDES permit. Many BMP techniques are available, including street sweeping, parking restrictions during periods when street sweeping will take place, elimination of or periodic cleaning of catch basins, public cooperation to help eliminate street litter, and improved erosion control in construction areas. No particular BMP techniques have been specifically identified at this time as a part of the storm sewer alternative.

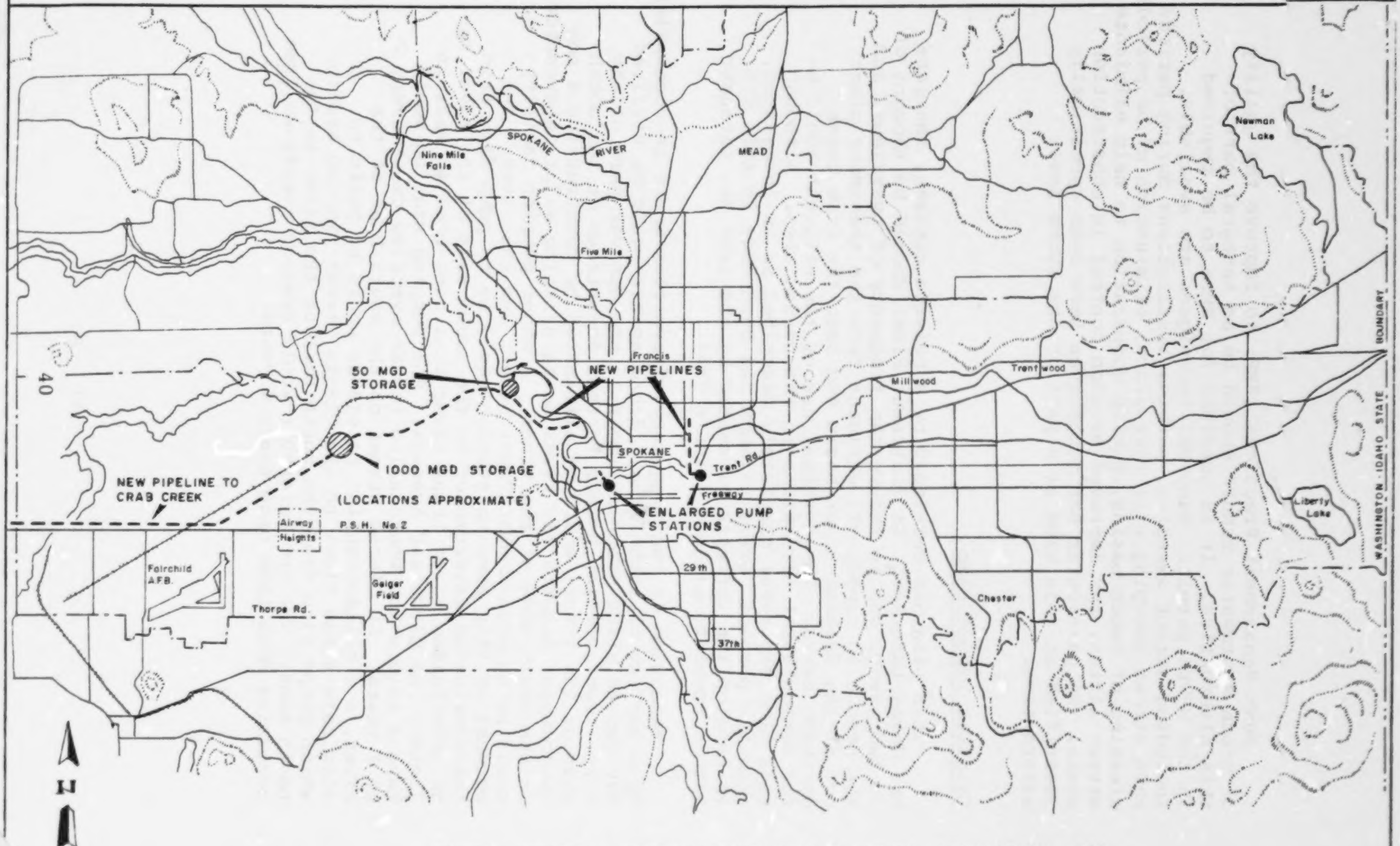
Latenser Export Plan

This plan was developed by a private citizen, the late Mr. James Latenser. It (Latenser Plan) should be thought of in two parts, one to reduce the frequency of overflows, and the second to export all effluent from the treatment plant out of the Spokane River basin and into the Crab Creek drainage basin. The eventual use of the effluent would be for agricultural irrigation in the Odessa area. Although this plan was never completely described as an integrated, feasible project, every attempt has been made in this EIS to develop the concepts presented by the late Mr. Latenser into a complete project (Figure 2-6).

Reduction in the frequency of overflow would be accomplished by a variety of techniques. Storm sewers would be utilized for two existing overflow areas in the upriver part of the city. Two overflow points further downstream on the north side of the river, would be eliminated by constructing a new interceptor beneath the river to an existing major interceptor on the south side of the river. A major pumping facility would be constructed at Trent Street and the river. The purpose of this pumping station would be to pump flow from the overloaded interceptor on the south side of the river to an underloaded major trunk sewer that runs east to west in Jackson and Cleveland Avenues. The pumping station would have a size which would allow for an overflow event every 2 to 3 years. At Clarke Street on the south bank of the river, a 2-million-gallon reservoir would be built to eliminate surge flows to the Clarke Street pumping station, which pumps flow from the south bank of the river to the north bank. The new reservoir would prevent overflows from occurring more than once every 4 years.

FIGURE 2-6

LATENSER PLAN FACILITIES


Nine Mile Falls
SPOKANE
RIVER
MEAD
Newman Lake
Five Mile
Francis
NEW PIPELINES
50 MGD STORAGE
Millwood
Trentwood
SPOKANE
Trent Rd.
Freeway
1000 MGD STORAGE
(LOCATIONS APPROXIMATE)
ENLARGED PUMP STATIONS
NEW PIPELINE TO CRAB CREEK
Airway Heights
P.S.H. No 2
Fairchild A.F.B.
Geiger Field
Thorpe Rd.
29th
37th
Chester
Liberty Lake
WASHINGTON - IDAHO STATE BOUNDARY
N

SOURCE: MODIFIED FROM SPOKANE CITY PLANNING COMMISSION, 1966

The above facilities were intended to prevent or lessen overflows at points upstream of the major overflow point at Meenach Drive. To eliminate this overflow, a 110-inch pipeline would be constructed across Fort Wright Bridge, and then flow by gravity through Riverside State Park to a 50-million-gallon open reservoir located somewhat downstream of the treatment plant (Figure 2-6). This open reservoir would be about 350 feet long, 1,000 feet wide, and 20 feet deep (8 acres in area), and would store untreated wastewater/stormwater until the storm has passed and treatment capacity is available. The reservoir would allow an overflow event every 1 to 2 years. A 72-inch pipeline would be used to gradually convey flow from the open reservoir, across a bridge to the treatment plant.

The exportation portion of this alternative begins at the treatment plant, where disinfected secondary effluent would be pumped 3 miles to a 1 billion-gallon storage reservoir located near Lyons. This reservoir would provide 30 days of storage, and allow gradual discharge of the disinfected secondary effluent to Crab Creek through an 18-mile pipeline. The disinfected secondary effluent would flow down Crab Creek to the Odessa area. A reservoir with a detention time of 60 days would be required at this location to regulate distribution to irrigated lands. The plan was never developed to a level which defined the exact location of the reservoirs which could be located either instream or at a location adjacent to Crab Creek. From the reservoir, the effluent would be conveyed to an irrigation distribution system serving over 10,000 acres of agricultural land.

The estimated costs for the Latenser Export Plan, divided into overflow prevention and exportation components, are given in Table 2-2.

Table 2-2

COSTS FOR LATENSER EXPORT PLAN

	Construction Cost-$	Operation and Maintenance Cost-$/yr
Overflow Prevention (and relief sewers)	70,072,400	297,900
Export for Irrigation	35,573,000	290,000
Totals	105,645,400	587,900

A Combination Pollution Control and Drainage Concept

As supplemental information to the city Facilities Plan, the EPA requested information on the cost of storage basin plans which would allow overflow events more frequently than once every 25 years. The data were used to construct a curve which showed that the cost-effective storage basin solution, from a monetary standpoint only, would allow one overflow event per year.

Based on one overflow event per year a combination pollution control and drainage concept was developed using the 15 overflow groupings contained in the city's Plan B (as modified) for storage basins. The objective was to determine for each overflow grouping whether the annual cost for storage basins sized for one overflow per year, plus the annual cost of relief sewers, was less than the annual cost of separate storm sewers. The analysis determined that storage basins plus relief sewers are more cost-effective for 7 of the 15 overflow groupings, and that storm sewers are more cost-effective for the remaining 8 overflow groupings (see Figure 2-7).

The order in which these projects would be implemented would be determined as was previously described for storm sewers. Using the annual cost per unit volume of overflow eliminated, those projects with the lowest cost/volume of overflow eliminated would be constructed first. A plot was made of the cumulative percent of volume removed vs. the cumulative percent of total annual cost, and the plot is shown in Figure 2-8. Lines have been drawn to show the point when the first two overflow groupings are corrected, a project which would correct 85.9 percent of the overflow for only 41.9 percent of the total annual cost. The priority ranking for the projects, as well as whether the projects would be storm sewers or storage basins plus relief sewers, is shown in Appendix C.

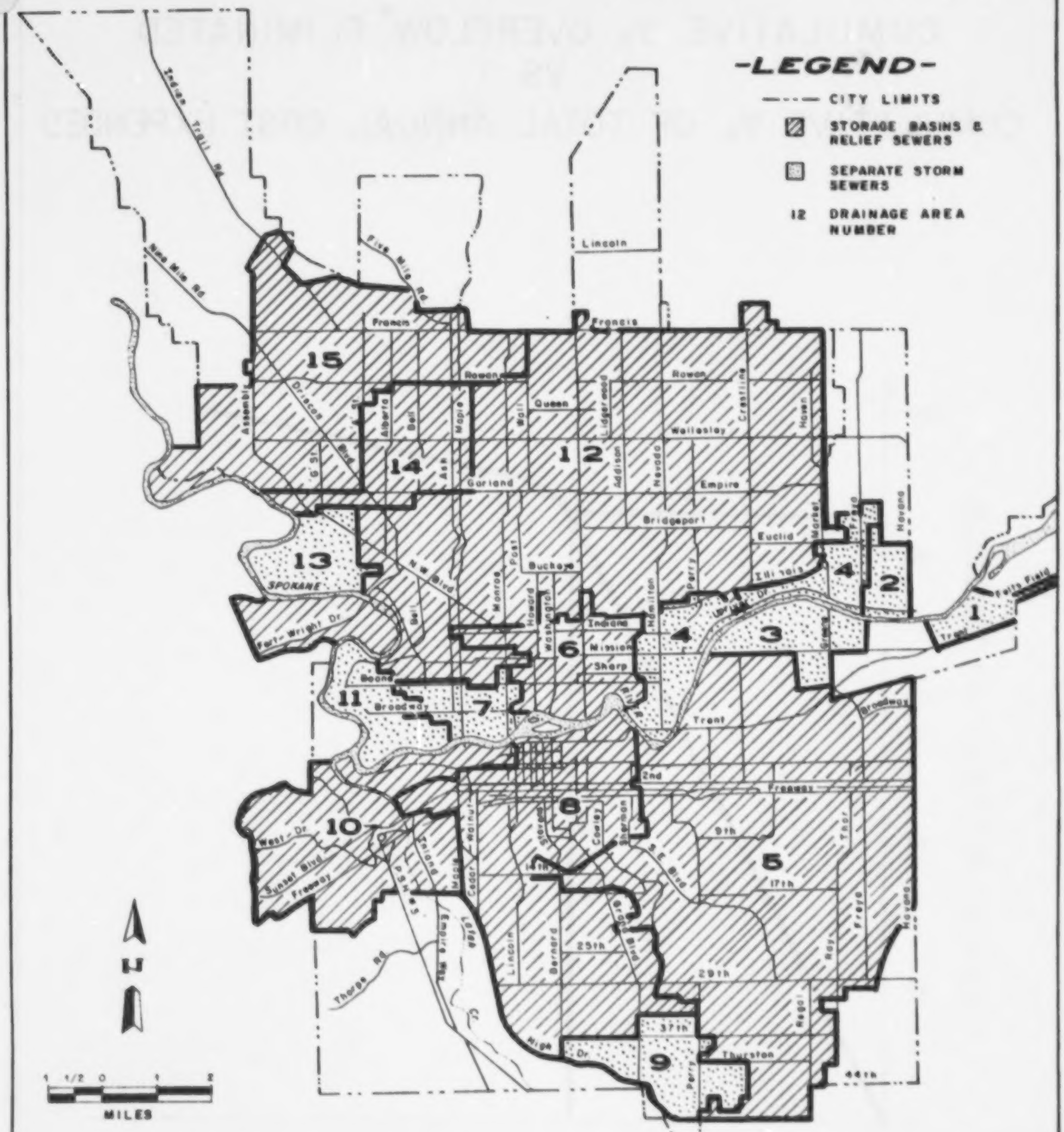
The estimated construction cost, using the most cost-effective technique for each overflow grouping, is $53,084,000 and the estimated operation and maintenance costs are $758,450 per year.

An Alternative for CSO Control Only

An alternative consisting only of storage basins could be implemented to solve the CSO problem. The storage basins would be identical to those described in Alternative 1. The basic problems with this concept are that it only accomplishes one of the three project objectives, the protection

FIGURE 2-7

COMBINATION CONCEPT DRAINAGE AREAS & PROPOSED CSO CONTROL METHODS



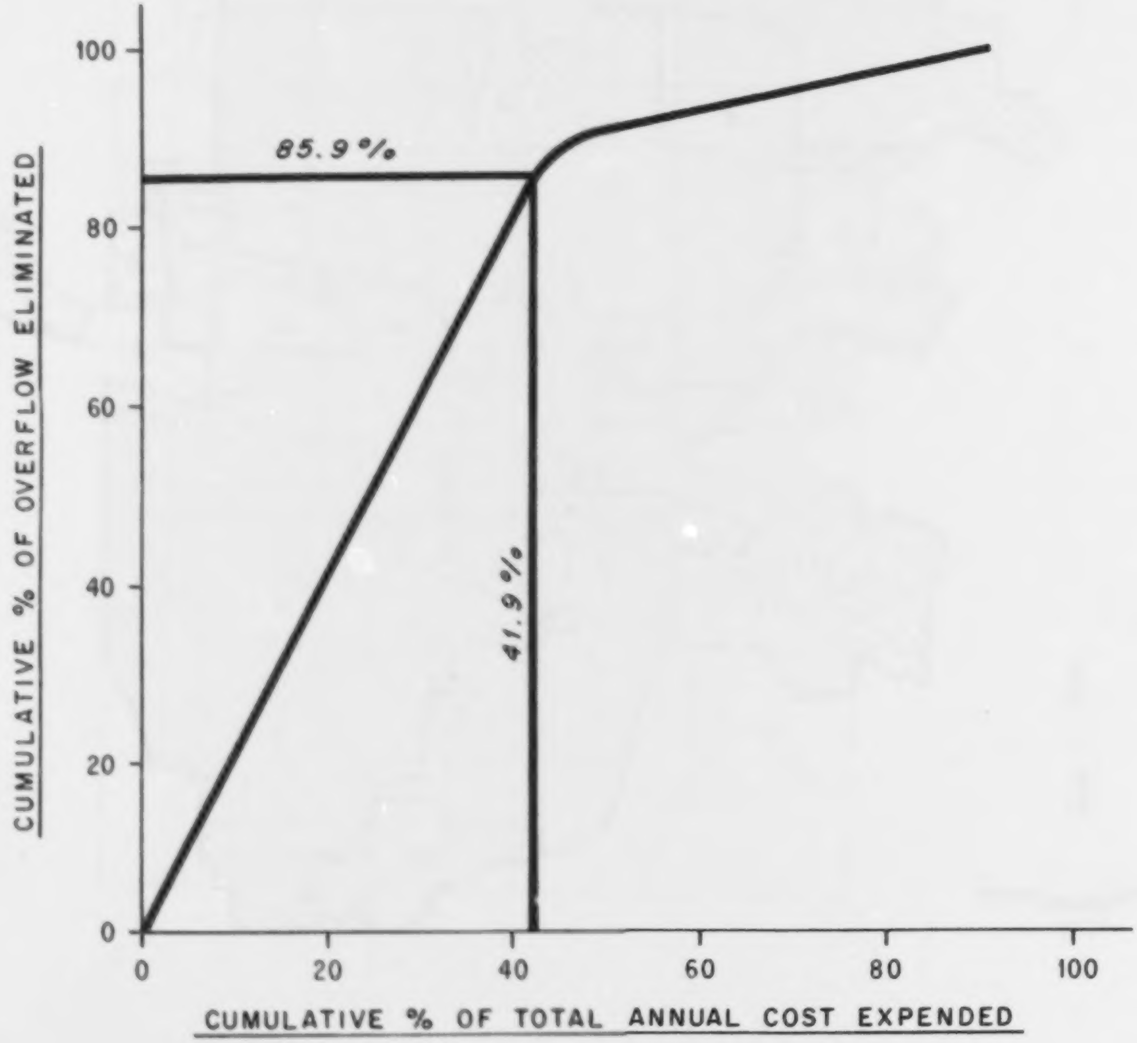
-LEGEND-
CITY LIMITS
▨ STORAGE BASINS & RELIEF SEWERS
▩ SEPARATE STORM SEWERS
12 DRAINAGE AREA NUMBER
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
SPOKANE
Indian Trail Rd
Nine Mile Rd
Five Mile Rd
Lincoln
Francis
Rowan
Queen
Wellesley
Garland
Empire
Bridgeport
Euclid
Buckeye
Illinois
Indiana
Mission
Sharp
Boone
Broadway
Trent
2nd
Freeway
9th
17th
25th
29th
37th
44th
Thurston
Fort Wright Dr
West Dr
Sunset Blvd
Thorpe Rd
Assembly
Driscoll Blvd
Alberta
Ash
Maple
Post
Monroe
Howard
Washington
Addison
Nevada
Crestline
Haven
Market
Hamilton
Perry
Greene
Havana
Freya
Regal
Ray
Thor
Lincoln
Bernard
Cedar
Walnut
Sherman
Cowley
S.E. Blvd
Felts Field
Trent
N
1 1/2 0 1 2
MILES

SOURCE: MODIFIED FROM SPOKANE CITY DEPARTMENT OF PUBLIC WORKS, 1977, EXHIBITS

FIGURE 2-8

COMBINATION POLLUTION CONTROL DRAINAGE CONCEPT:

CUMULATIVE % OVERFLOW* ELIMINATED VS CUMULATIVE % OF TOTAL ANNUAL COST EXPENDED



* OVERFLOW CONSIDERED ON A VOLUME BASIS

of downstream water quality. The other two objectives, solution of drainage and basement flooding problems, and the ability to utilize the existing treatment facility as a regional facility, are not achieved by this alternative. On this basis, the concept was dismissed from further consideration.

County Regionalization Scenarios

Considerable planning has been conducted in the past relating to the City of Spokane's treatment plant becoming a regional plant which would also serve the unincorporated areas in North Spokane and the Spokane Valley. When the City of Spokane's plant was in the planning stage, the site layout was arranged to accommodate flow from these areas. Overall, the plant site has sufficient land area for 60 mgd of average daily flow, assuming no additional treatment processes are required in the future.

The anticipated year 2000 average dry weather flow for the City of Spokane is 34.25 mgd, for the North Spokane area 5.8 mgd, and for the Spokane Valley 16.15 mgd, for a total of 56.2 mgd. This flow could only be suitably treated, however, if storm sewers are constructed, thereby creating capacity in the interceptors and treatment plant. (It would also be necessary to sewer all of the residences in the county areas.) Thus, there is a net benefit, or credit, which could be assigned to storm sewer construction because it would allow regionalization. This credit has an estimated equivalent annual cost of $3.03 million per year, as shown in Table 5-2. The credit calculation used a planning period of 1985-2005 rather than 1980 to 2000 because it is estimated that sewer separation would not make capacity in the city system available until 1985 at the earliest. A planning analysis for regionalization using city interceptor and treatment capacity is presently being done by the county. Some of the draft data from that analysis are used in the regionalization sections of Chapter 4.

Other CSO Options

The only other concepts which are in common usage for CSO control besides those already described, are the use of in-system computerized routing and screening of the overflow. In-system routing can be utilized where there are large sewers available with many inter-connections. The concept works by using the large volume of the sewers to store flow, and then to release it gradually to treatment after the storm flow has subsided.

Screening is very commonly used at overflow points to remove both floatable material and suspended solids. Although it is quite successful in this regard, screening would not solve problems related to the overflow of fecal coliform organisms or dissolved pollutants.

No-Action Alternative

The EPA regulations for the preparation of an Environmental Impact Statement (EIS) require that a "No-Action" alternative also be evaluated and compared with the other alternatives being considered. The no-action alternative for the City of Spokane would entail the continuation of the existing CSO situation which was described earlier. Contamination of the Spokane River with floatable material, fecal coliform organisms, suspended solids, organic matter and phosphorus would continue. Changes would probably not be made to relieve existing drainage and basement flooding problems, and these problems would continue and gradually worsen as the city grows and more areas are paved, thus increasing runoff.

Summary of Alternative Costs

Table 2-3 summarizes the costs of the alternatives which have been discussed in this chapter. A point to note is that the Klicker suboption to Alternative 1 does not include relief sewers to alleviate basement flooding, but instead uses check valves and on-site storage for 700 connections, a concept which is considerably less expensive than relief sewers. The concept of check valves and on-site storage basins does not have the endorsement of the City of Spokane, and therefore should be considered as an unresolved issue. Also, documentation is not available to determine whether check valves would be required for only 700 homes over the 20-year planning period.

Table 2-3

SUMMARY COMPARISON OF ALTERNATIVE COST

	Construction Cost $	O&M Cost $/Yr.	Average Annual Cost - $/Yr.***
1. City Alternative #1-Storage Basin			
a. Storage Plans A, B, and C			
25/yr frequency storm*	$101,720,000	$771,560	$10,371,660
1/yr frequency storm*	53,979,000	771,560	5,878,770
b. Klicker Suboption**	60,538,200	837,150	6,568,190
2. City Alternative #2-Satellite Treatment Plants*	95,819,000	474,700	11,401,280
3. City Alternative #3-Storm Sewers	64,050,000	152,930	6,806,510
4. Latenser Export Plan*	105,645,400	587,900	11,085,750
5. Combination Pollution Control and Drainage Concept*	53,084,000	758,450	6,090,940

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* Includes relief sewers to eliminate basement flooding.

** Includes an on-site storage tank and check valves at connections which are susceptible to basement flooding.

*** The average annual cost comparison was developed following methods used in the city facilities plan (Spokane City Department of Public Works, 1977 Exhibits).

Chapter 3

LAWS, RULES AND POLICIES AFFECTING THE CSO ABATEMENT PROJECT

Introduction

The following pages briefly describe those federal, state and local laws, regulations and policies that have prompted and are guiding Spokane's plans to correct its combined sewer overflows (CSO) to the Spokane River. The discussion has been subdivided into three general categories: the first lists those laws and regulations that have prompted Spokane to action on CSO; the second describes the planning and funding guidelines that are affecting identification of the best CSO project; and the third summarizes other laws and regulations that could affect actual construction and operation of any of the proposed CSO abatement alternatives.

Laws, Actions Prompting CSO Abatement Planning

Under Section 303 of the Clean Water Act (formerly the FWPCA but renamed the Clean Water Act in 1977 by PL 95-217), the states are required to prepare and enforce minimum water quality standards for the nation. These water quality standards are subject to EPA review and approval. Sections 401 and 402 of the 1972 amendments (PL 92-500) established the National Pollutant Discharge Elimination System (NPDES), which requires a permit for any discharge of pollutants to navigable waters. In order to comply with the act's timetable, all wastewater treatment plants discharging to navigable waters were to meet the federal secondary treatment effluent requirements by July 1, 1977 (listed in Federal Register, Volume 40, No. 159, August 15, 1975; subsequent legislation has allowed EPA to extend this compliance date to July 1, 1983 on a case-by-case basis). By July 1, 1983 all municipal treatment facilities must have instituted "Best Practicable Waste Treatment Technology". The ultimate goal of the act is to reach a condition of no discharge of pollutants to the nation's waterways by July 1, 1985. Section 502(6) of the act defines pollutant as any "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge . . . and industrial, municipal and agricultural waste discharged into water." In this definition, complete elimination of wastewater discharge is not implied; only elimination of discharge of pollutants contained in treated wastewater.

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In order to meet these federal mandates, the City of Spokane planned, designed and constructed a secondary wastewater treatment facility with phosphorus removal, which was completed in 1977. This facility is capable of adequately treating all of Spokane's dry weather flows, but only a portion of the combined storm and sanitary wet weather flows. The NPDES permit (WA-002447-3) issued by the State Department of Ecology to regulate this improved discharge required that steps be taken to eliminate dry weather and high water overflows from specific storm outfalls in the city and that a facilities plan for correction of all combined sewer overflows be prepared. Subsequent Department of Ecology directives (Order Docket Nos. 77-335 and 77-833) have established a time frame for these city actions. The city eliminated the dry weather overflows in early 1978.

The current time frame calls for a start of construction to remedy the two largest overflows (Meenach and Hollywood) by January 1979, with completion in 4 years. One of the major overflow prohibitions in the NPDES permit states "the discharge emanating from any combined sewer overflow or sewage bypass structure(s) must not violate the applicable Water Quality Standards (WAC 173-201) after June 30, 1977". The present combined sewer overflows violate these state standards in terms of fecal coliform levels, turbidity, deleterious and toxic materials, and impairment of aesthetic values for Class A streams. The water quality standards have therefore provided one of the main catalysts for CSO abatement planning. A complete listing of Class A stream water quality standards can be found in Washington State Water Quality Standards (Washington State Department of Ecology, 1977).

In response to these directives, the city prepared a facilities plan for sewer overflow abatement in 1977. This plan studies several alternative solutions to CSO, including storage, satellite treatment and separate storm sewers. This EIS has been prepared to analyze the CSO abatement facilities plan.

Laws and Guidelines that Affect the Scope of CSO Planning

There are two major pieces of federal legislation and several federal funding guidelines that are presently directing the scope of the Spokane CSO facilities planning process. Under Section 201 of the Clean Water Act, EPA can administer grant funds for facilities planning effort. The EPA's regulations of 40 CFR, Part 35, implement this authority. The Spokane CSO Abatement Facilities Plan and this EIS are part of the 201 planning process. In order to receive federal funding for design and construction of facilities, the planning process and the eventual project must comply with EPA guidelines and regulations developed under Section 201 of the act. The planning process must also comply with the EPA's regulations dealing with environmental impact statements (40 CFR, Part 6). Spokane has therefore investigated a variety of approaches to CSO control as required in 201 planning guidelines in hope of receiving 75 percent federal funding for their project. The State of Washington can also provide 15 percent funding of projects that meet their requirements.

In order to establish a uniform means of assessing CSO projects and to fairly distribute the federal funds that are available for wastewater facilities, EPA has prepared two program management memoranda. The first memorandum, PRM 75-34 (also referred to as PG-61), establishes planning requirements and project approval criteria for CSO projects. The planning requirements include consideration of alternative control techniques, development of costs for the most feasible CSO control measures, analysis of the impacts on beneficial uses for various levels of CSO control and consideration of the costs and benefits of adding tertiary treatment to dry weather flows. Project approval criteria stipulate that the selected alternative must be necessary to protect a beneficial use even after industrial and other point source pollution is controlled. It is also essential that funding to provide secondary treatment of dry weather flows has been assured, that the proposed CSO control technique is the most cost-effective means of protecting the beneficial use, and that marginal costs are not substantial compared to marginal benefits. PRM 75-34 also requires that costs be allocated to the various purposes of a project when it serves more than just a means of pollution control. It is important to note that the pollution control benefits of an action may in some cases be of a regional rather than a single project nature. PRM 77-4 deals with allocation of costs for CSO projects that are considered to be multi-purpose (e.g., they provide for more than just water pollution control). This policy basically states that construction grant funding will be available only to that level allocated for the pollution control purpose. In no case will the federal funding exceed the cost of the least cost single-purpose pollution control alternative. These program management memoranda are also discussed in the Environmental Consequences chapter of this report. Both memoranda have been used in developing and analyzing the Spokane CSO control alternatives in this EIS.

Because the Spokane CSO facilities planning effort is receiving federal funding administered by EPA, EPA is required to comply with the National Environmental Policy Act (NEPA) and to prepare an Environmental Impact Statement (EIS) if the project is found to have significant environmental impacts. This legal requirement has also had a major effect on the scope of the facilities planning effort. Several alternative projects are being considered in the EIS that were not developed by the city in its facilities plan. This responds to NEPA's requirement to consider all feasible alternatives. The EIS process also encourages more public participation in planning wastewater facilities. Several public workshops and meetings have been held in Spokane during preparation of this EIS. Through the EIS process, EPA must also ensure that other federal environmental laws and regulations are heeded. This includes the Fish and Wildlife Coordination Act, the Anadromous Fish Conservation Act, the National Historic Preservation Act of 1966, the Federal Endangered Species Act of 1973, the Federal Clean Air Act, the Federal Safe Drinking Water Act, and others. Several of these laws are mentioned in more detail below.

Other Laws, Rules and Policies Influencing CSO Abatement Planning

As mentioned above, EPA must ensure that all federal environmental legislation is adhered to when supplying federal funds for local water pollution control facilities. In administering the Federal Clean Air Act, EPA has established National Ambient Air Quality Standards (NAAQS; see Table 3-1). These standards are designed to protect human health from the effects of chronic air pollution. Any project that creates local air pollution conditions in excess of NAAQS or which conflicts with the strategy presented in an approved State Implementation Plan may have federal funding withheld under Section 316 of the Clean Air Act. The Washington Department of Ecology has also established air quality standards for the state (Table 3-1). Because the state and federal standards for suspended particulates and carbon monoxide are periodically violated in the Spokane area, the Department of Ecology and the Spokane County Air Pollution Control Authority (SCAPCA) initiated a nonattainment planning program in 1976. The Spokane CSO abatement planning effort must consider its influence on this local air quality maintenance planning. This EIS discusses the influence of the proposed alternatives on local air quality and mentions the planning efforts being made to remedy existing air quality problems in the Spokane area.

Table 3-1

NATIONAL AND STATE AIR QUALITY STANDARDS

POLLUTANT	MEASUREMENT CLASSIFICATION	NATIONAL AMBIENT AIR QUALITY STANDARDS						DEPARTMENT OF ECOLOGY AMBIENT AIR QUALITY REGULATIONS					
		PRIMARY STANDARDS			SECONDARY STANDARDS			AIR QUALITY STANDARD			AIR QUALITY OBJECTIVE		
		(ug/m^3)*	(ppm)**	(mg/m^3)***	(ug/m^3)*	(ppm)**	(mg/m^3)***	(ug/m^3)*	(ppm)**	(mg/m^3)***	(ug/m^3)*	(ppm)**	(mg/m^3)***
Suspended particulates	Annual geometric mean	75	-	-	60	-	-	60	-	-	-	-	-
	Maximum 24-hour average (1/yr)	260	-	-	150	-	-	150	-	-	-	-	-
	Annual median	-	-	-	-	-	-	-	-	-	30	-	-
Sulfur oxides measured as SO_2	Annual arithmetic mean	80	0.03	-	-	-	-	60	0.02	-	-	-	-
	Maximum 24-hour average (1/yr)	365	0.14	-	-	-	-	260	0.10	-	-	-	-
	Maximum 3-hour average (1/yr)	-	-	-	1300	0.50	-	-	-	-	-	-	-
	Maximum 1-hour concentration	-	-	-	-	-	-	1048	0.40	-	-	-	-
	Maximum 1-hour average (2/7days)	-	-	-	-	-	-	655	0.25	-	-	-	-
	Maximum 5-minute average	-	-	-	-	-	-	-	-	-	786	0.3	-
Carbon monoxide (CO)	Maximum 8-hour average (1/yr)	-	9	10	-	9	10	-	9	10	-	-	-
	Maximum 1-hour average (1/yr)	-	35	40	-	35	40	-	35	40	-	-	-
	Maximum 24-hour average	-	-	-	-	-	-	-	-	-	6	5	-
Photochemical oxidants	Maximum 1-hour average (1/yr) (1000-1600 PST)	160	0.08	-	160	0.08	-	160	0.08	-	-	-	-
Hydrocarbons (Less Methane)	Maximum 3-hour average (1/yr) (0600-0900 PST)	160	0.24	-	160	0.24	-	160	0.24	-	-	-	-
Nitrogen dioxide (NO_2)	Annual arithmetic mean	100	0.05	-	100	0.05	-	100	0.05	-	-	-	-

*micrograms per cubic meter
**parts per million
***milligrams per cubic meter

Note: Department of Ecology Standards for Photochemical Oxidants and Hydrocarbons refer to the time period April 1 through October 31.

EPISODE LEVELS						
STAGE Triggered by any one of the listed pollutant levels	ONLY SO2 (24-Hour Average)	ONLY PARTICULATE (24-Hour Average)	PRODUCT SO2 & PARTICULATE (24-Hour Average)	ONLY CO (Cont. 8-Hour Averages)	ONLY OXIDANT (As Ozone" 1-Hour Average)	ONLY NO2 (1-Hour Average & 24-Hour Average)
ALERT First Stage of Pollutants has been reached and Forecast Indicates continued 12 hours at or above these levels.	0.3 ppm (800 ug/m^3)	3.0 COHS or 375 ug/m^3	ppm SO2 x COHS= 0.2 or ug/m^3 SO2 x ug/m^3 Particulate= 65 x 10^3	15 ppm (17 mg/m^3)	0.2 ppm (400 ug/m^3) (O_3)	0.6 ppm (1130 ug/m^3) 1-Hour Avg. 0.15 ppm (282 ug/m^3) 24-Hour Avg.
WARNING Pollutant levels are continuing to degrade and additional controls are necessary.	0.6 ppm (1600 ug/m^3)	5.0 COHS or 625 ug/m^3	ppm SO2 x COHS= 0.8 or ug/m^3 SO2 x ug/m^3 Particulate= 261 x 10^3	30 ppm (34 mg/m^3)	0.4 ppm (800 ug/m^3)	1.2 ppm (2260 ug/m^3) 1-Hour Avg. 0.3 ppm (565 ug/m^3) 24-Hour Avg.
EMERGENCY Air pollution levels are continuing and most severe control measures are required.	0.8 ppm (2100 ug/m^3)	7.0 COHS or 875 ug/m^3	ppm SO2 x COHS= 1.2 or ug/m^3 SO2 x ug/m^3 Particulate= 393 x 10^3	40 ppm (46 mg/m^3)	0.6 ppm (1200 ug/m^3)	1.6 ppm (3,000 ug/m^3) 1-Hour Avg. 0.4 ppm (750 ug/m^3) 24-Hour Avg.

SOURCE: Spokane County Air Pollution Control Authority, pers. comm.

The Federal Safe Drinking Water Act of 1974 required EPA to set standards for drinking water quality and to establish guidelines for state regulation and enforcement of these standards. It also gave EPA the responsibility of protecting underground sources of drinking water. National interim primary drinking water regulations were released by EPA in 1975 (Federal Register, Vol. 40, No. 248 - Wednesday, December 24, 1975). They became enforceable in June of 1977. Any option of land disposal or surface storage of wastewater must be analyzed by EPA for its effects on local drinking water supplies. In addition, this EIS is considering the option of making the Spokane treatment plant a regional facility, providing wastewater treatment to surrounding county areas that now utilize septic tanks. This could indirectly affect local water supplies in that septic tanks are suspected of contaminating the Spokane Valley aquifer, which is the sole source of domestic water supply for most of Spokane County.

Any plans to implement a scheme of wastewater reclamation and irrigation reuse as proposed in the Latenser alternative would be guided in part by the DOE proposed guidelines for land disposal of treated domestic sewage effluent (Washington State Department of Ecology, 1976). These guidelines establish minimum treatment levels and coliform bacteria standards for various types of reuse. For irrigation of fodder, fiber and seed crops, primary treatment and disinfection to a maximum geometric mean of 230 total coliforms per 100 milliliters is required. Wastewater used to irrigate dairy cattle pasture must receive at least secondary treatment and disinfection must reduce total coliform bacteria to no more than 23 organisms per 100 milliliters.

The DOE advanced waste treatment policy would also influence the Latenser irrigation reuse scheme. One of the policy stipulations is that any new wastewater discharge to a stream (i.e., Crab Creek) must receive at least 20:1 dilution by the stream's average daily minimum flow. This policy could severely restrict the volume of wastewater discharged to Crab Creek during the creek's low flow periods.

Streamside construction along either the Spokane River or Hangman Creek must be conducted with careful consideration of Spokane's shoreline master program (Spokane City Plan Commission, 1976). This planning document has established a long-range development program and supporting objectives and policies that affect any activity along the city's waterways. A series of subarea design plans specify desired land uses and activities on properties adjacent to the river and mapped plan elements identify recreation, economic development, public access, circulation, conservation, and historical and cultural features that are part of the plans.

Construction of storm sewers, storage basins or satellite treatment facilities in the shoreline planning area must be conducted so as not to conflict with the plan's objectives and policies.

Construction activities associated with CSO abatement will be guided by a variety of state and local permit requirements and regulations. The State Department of Game must issue a hydraulic project permit prior to any work that might influence flows in the Spokane River or other area waterways. Export of Spokane wastewater (Latenser Plan) or construction within or across a stream channel would require such a permit. Construction activity is not currently subject to state noise control regulations unless it is located in a residential area between 10:00 p.m. and 7:00 a.m., but a state construction noise ordinance is currently being developed (Saunders, pers. comm.). This project may or may not be influenced by this ordinance. Numerous local regulations will influence the methods and timing of construction within the Spokane area. Construction contractor's practices are regulated in large part by the "Standard Specifications for Municipal Public Works Construction, Washington State Chapter, American Public Works Association, 1967". The City of Spokane also has a "Special Supplementals to Standard Specifications", which guides such activities as traffic control, easement maintenance, utilities relocations and trenching (Spokane City Department of Public Works, n.d.).

Chapter 4

ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Introduction

This chapter of the report discusses the major environmental issues associated with the City of Spokane's proposed CSO abatement plans. The issues have been identified through the process of planning CSO abatement alternatives and discussions with local, state and federal agencies and numerous Spokane area citizens. Each subsection deals with an individual issue; the issue is identified, pertinent background data are identified or cited, the relationship of each CSO option to the issue is discussed and mitigation measures are suggested where significant adverse environmental impacts have been identified.

Disruptions Caused by Construction Activities

Extensive street construction in an urban environment can create a wide range of significant though short-term nuisances and disruptions. The following discussion of construction-related impacts is therefore broken down into several subtopics, including land use and development, noise, aesthetics, public safety, traffic disruptions and population dislocations. The impacts of each CSO abatement alternative are discussed under each of these subheadings. The size and location of facilities for the three city alternatives was assumed to be as described in the CSO Abatement Facilities Plan unless otherwise indicated (Spokane City Department of Public Works, 1977). If facilities are eventually sized to smaller capacities, the construction impacts described herein would be reduced accordingly.

Land Use and Development

Alternative 1 - Storage Basins and Relief Sewers. This alternative would require approximately 60 acres of public and private land for basin construction and buffer zones, and would require relief sewer construction in 55 miles of city streets (Gellner, pers. comm.). This acreage figure assumes all storage basins would be designed to hold the 25-year-frequency storm; if a 1-year storm capacity was used for sizing, less than 20 acres of land would be needed. In most cases, land would be restored to its previous use upon completion of construction. However, disturbance of land uses during construction would be significant at several

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of the larger storage basins, due to the extent of area disturbed (see Figure 2-3) and the 12-18 months required for construction (also see Long-Term Effects of New Facilities on Adjacent Land Use). In order to assess the short-term impacts on adjacent land use, each of the city's census tracts were separately analyzed and then aggregated to form the northwest, northeast, southwest and southeast quarters of the city. Figure 4-1 shows census tracts within the city to assist in interpretation of Tables A-1 through A-10. The following describes anticipated impacts by geographical division.

Residential - City of Spokane. Impacts of relief sewer construction would be similar to those described later for Alternative 3, but would affect a smaller area. With the general exception of the central portions of the city, residential development would be affected to about the same extent in all four sections of the city. In one area of the central city permanent relocation or demolition of homes may be required to accomplish storage basin construction. When storage basin construction is required in close proximity to residential development, major problems could be expected in terms of street obstructions, dust, noise, loss of aesthetics, and public safety hazards. See Table A-1 for a summary of residential impacts by census tract.

Residential - Northwest Spokane. Relief sewer construction would primarily impact single-family residential development. The northwest corner would be most heavily impacted by sewer construction. Storage basin 14B would be located adjacent to residential development on Northwest Boulevard (see Figure 2-3). As construction of 14B would occur within the Northwest Boulevard right-of-way significant adverse impacts could be expected on the adjacent high quality residential area located on Northwest Boulevard.

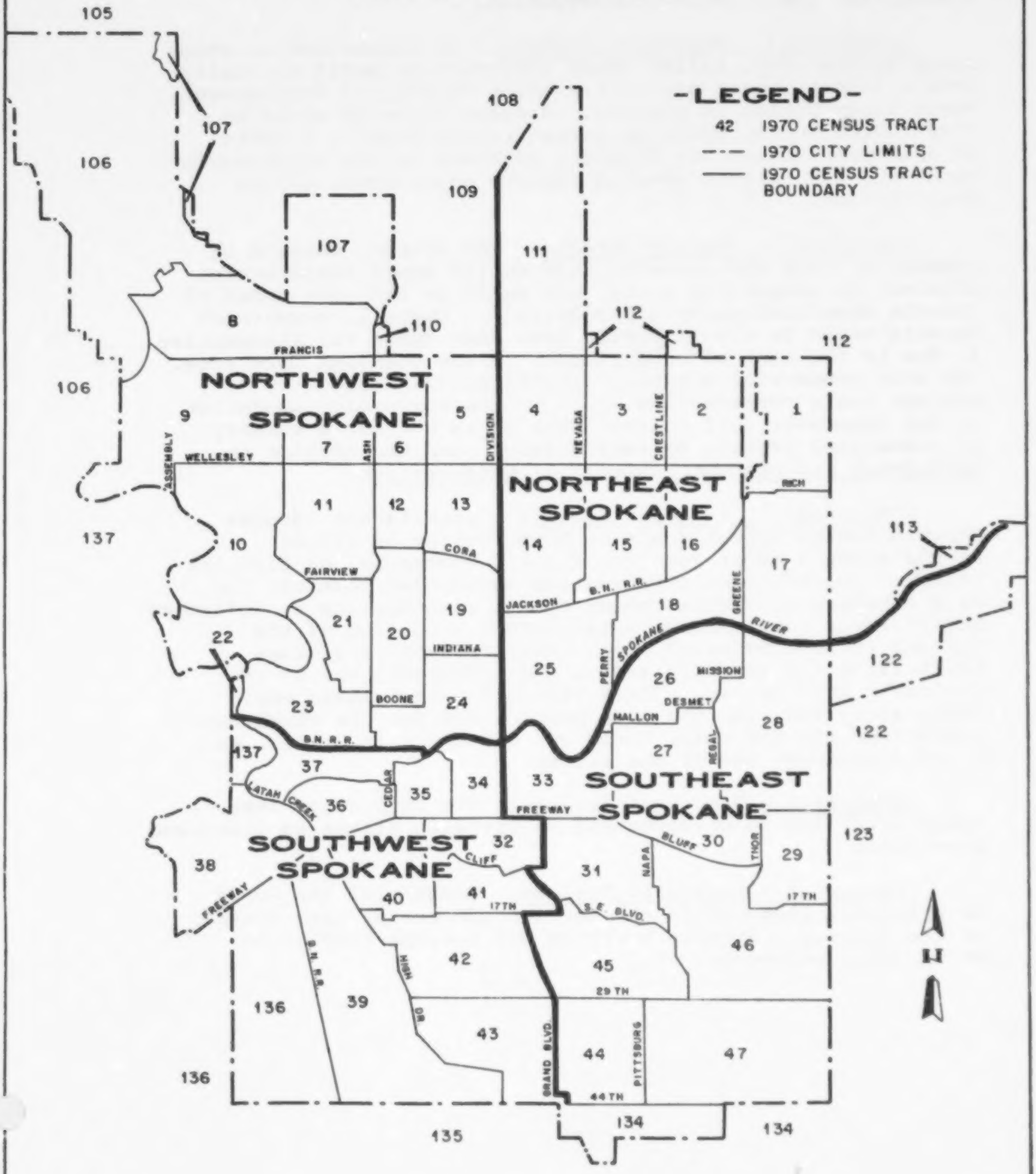
Storage basin 13B would require construction adjacent to the attractive residential area bordering Downriver Golf Course with resulting significant adverse impacts. Storage basin 11B would have a minor impact on several older homes to the southeast of the site.

Residential - Northeast Spokane. Relief sewer construction would occur along the entire length of four major north-south residential streets with resulting disruptive impacts. Storage basin 2B would be constructed in the Upriver Drive right-of-way and would adversely impact the adjacent single-family development. Storage basin 4B is sited some distance from residential development and would have a minor impact.

Residential - Southwest Spokane. Relief sewer construction would occur in both single-family and multi-family residential areas. The most serious impacts, however, are anticipated from construction of storage basin 8B in the Peaceful Valley residential area, under the Maple Street Bridge. Peaceful Valley is the oldest residential area in the city and contains a number of old homes in varying states of disrepair. Although,

FIGURE 4-1

SPOKANE, WASHINGTON CENSUS TRACTS


-LEGEND-
42 1970 CENSUS TRACT
1970 CITY LIMITS
1970 CENSUS TRACT BOUNDARY
NORTHWEST SPOKANE
NORTHEAST SPOKANE
SOUTHEAST SPOKANE
SOUTHWEST SPOKANE
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FRANCIS
WELLESLEY
ASSEMBLY
ASH
DIVISION
NEVADA
CRESTLINE
RICH
CORA
FAIRVIEW
JACKSON
B.N. R.R.
GREENE
SPOKANE RIVER
INDIANA
PERRY
MISSION
BOONE
DESMET
MALLON
REGAL
LATAH CREEK
CEDAR
FREEWAY
BLUFF
NAPA
THOR
CLIFF
17TH
S.E. BLVD.
29 TH
GRAND BLVD
PITTSBURG
44 TH
N

the precise location of the storage basin has not yet been determined, the 5.5-acre basin would appear to require removal of some of the homes, and would adversely impact remaining residential units during construction.

Residential - Southeast Spokane. In comparison to other areas of the city, relief sewer construction would generally have a lesser impact due to the lower density of development where construction is planned. Storage basin 3B would be constructed in the Riverton Street right-of-way. A number of apartment houses are directly adjacent to the construction site, and significant adverse impacts would occur during construction.

Commercial - City of Spokane. The primary impacts on commercial uses would result from relief sewer construction adjacent to commercial zones, and would be the same types of impacts described under Alternative 3. Overall, commercial impacts would be significantly less than those for Alternative 3, due to the lack of construction in the downtown core area. The only commercial activity significantly affected by storage basin construction would be the concession operation at the Downriver Golf Course. See Table A-2 for a summary of commercial impacts by census tract, and the section on Employment and Economic Impacts of Construction.

Commercial - Northwest Spokane. Significant adverse impacts can be expected due to construction of relief sewers along a major section of strip commercial on Division Street. Relief sewer construction would also obstruct the main entrance to Shadle Center due to construction on Wellesley. Relief sewer construction would affect a portion of the Garland strip commercial area. Construction of storage basin 13B could severely impact the commercial use at the Downriver Golf Course. The 8,700-square-foot basin would temporarily demolish the main parking lot for the clubhouse, restaurant and pro shop, would cut off the main access, and would discourage use of the course.

Commercial - Northeast Spokane. The only major impacts would occur due to construction on Division Street as discussed previously.

Commercial - Southwest Spokane. Commercial use would be primarily impacted in the service commercial area south of the freeway. Storage basin 8B may require demolition of an older warehouse.

Commercial - Southeast Spokane. The major impacts would result from relief sewer construction adjacent to the Eastown Shopping Center, Manito Center and service commercial area east of downtown. Construction would obstruct the Sprague and Myrtle entrances and affect the Havana access to Eastown and the Grand Boulevard access to Manito Center. Impacts on the eastern commercial area would generally be moderate. Storage basin 1B would involve construction adjacent to a linen supply distributor which may involve some traffic obstructions and inconveniences for that firm.

Industrial - City of Spokane. Industrial impacts would be limited chiefly to the eastern industrial area. Relief sewer construction would cause some traffic obstructions in industrial areas, but overall would not significantly impact industrial uses. Storage basin construction would have no significant impacts on industrial land use. See Table A-3 for a summary of industrial impacts by census tract.

Industrial - Northwest Spokane. There should be no impacts in this area.

Industrial - Northeast Spokane. Relief sewer construction would obstruct traffic on the major arterial serving a light industrial zone on Regal and Garland.

Industrial - Southwest Spokane. There should be no impacts in this area.

Industrial - Southeast Spokane. Construction of relief sewers would occur in major streets providing access to several heavy and light industrial areas extending from Trent to Riverside between Erie and Napa Streets.

Parks/Recreation Facilities - City of Spokane. According to the 1977 annual report, city-operated parks had an estimated attendance of 1,646,987 persons in 1977 (Spokane City Parks Board, 1977). The peak outdoor recreation season is from June to Labor Day, with the peak use periods for most neighborhood and community parks occurring on weekdays and evenings in those parks where organized evening programs are offered (Fearn, pers. comm.).

Relief sewer construction would affect street access and recreation use at a number of parks in the city, but impacts would not be as widespread or as potentially adverse as those described for Alternative 3 (discussed in a following section). Storage basin construction would occur in several major parks adversely affecting use in and adjacent to the work area.

Noise, dust and potential safety hazards of heavy equipment in proximity to recreation facilities and activity areas would constitute the major adverse impacts on recreation use. See Table A-4 for summary of impacts by census tract.

Parks/Recreation Facilities - Northwest Spokane. Relief sewer construction would have a minor impact on park use and facilities. Storage basin construction would adversely affect use at Downriver Golf Course as previously described. Storage basin 6, which has two potential locations according to the city's facilities plan (see Figure 2-3), would require construction in the north shore of Riverfront Park (2.5 surface acres). Option 1 would occupy a portion of the parking area for the park and could temporarily eliminate the footpath connecting this segment of the park to the section on the other side of Washington Street Bridge. Construction may also adversely affect use in the south shore section opposite the site, which includes an open air pavilion, picnic facilities and viewing area. Site option 2 would have a greater adverse impact. Construction would occupy a partially landscaped, vacant area planned eventually by park officials as a paved parking area, and a portion of the footpath bordering the river. Construction may temporarily eliminate the footpath and may adversely affect use and enjoyment of the nature center under construction just west of the site. Newly developed storage site 16B would be constructed near the river's edge in Downriver Park, temporarily disrupting use of a natural open area with excellent open space and scenic value.

Parks/Recreation Facilities - Northeast Spokane. Relief sewer construction would obstruct access and affect park use at several neighborhood parks. Construction of storage basin 4B would occur in the main parking lot of Mission Park, adjacent to the tennis courts and picnicking area and near the swimming pool. Use of the closest courts and picnic area can be expected to decline significantly during construction due to noise, dust and other nuisance factors.

Parks/Recreation Facilities - Southwest Spokane. Relief sewer construction would have a major impact on Manito Park due to the extensive access of perimeter areas affected. Storage basin 10B would occupy an undeveloped portion of High Bridge Park, significantly reducing use in the affected area. Storage basin 8B would be near Glover Field, potentially reducing use of that facility during construction.

Parks/Recreation Facilities - Southeast Spokane. Relief sewer construction would obstruct access and significantly affect use at Liberty and Underhill Parks. Storage basin construction would have no impact on park lands or facilities.

Public/Semipublic Facilities - City of Spokane. The largest category of facilities to be impacted by construction are the public and private schools located throughout the city. Combined enrollment for all schools within the city in 1977-78 averaged 30,322 (Spokane School District Number 81, 1977a). Schools hold regular sessions from September through May. Shadle Park High School conducts full summer school sessions. Many of the elementary schools conduct outdoor summer recreation programs. Regular school hours are as follows:

Elementary	
Morning Kindergarten	9:00 - 11:30
Afternoon Kindergarten	12:30 - 3:00
Grades 1-6	9:00 - 3:00
Junior High (Grades 7-9)	8:45 - 3:15
Senior High (Grades 10-12)	7:50 - 2:30

Although some schools within the district have shown enrollment increases, overall enrollment in the city has decreased from 1969 to present, and most schools are currently under capacity enrollment (Spokane School District Number 81, 1977).

Relief sewer construction would occur in streets adjacent to a number of schools and several major hospitals. Impacts would be similar to those described for Alternative 3, but with significantly fewer facilities affected. Storage basin construction would have no impact on public or semipublic facilities other than those previously described at Downriver Golf Course. See Table A-5 for a summary of impacts by census tract.

Public/Semipublic Facilities - Northwest Spokane. The main student and bus loading entrances to several schools would be impacted by relief sewer construction. Storage basin construction would adversely impact Downriver Golf Course facilities as previously discussed. Storage basin 16B construction would disrupt both access and normal use of Rivercrest Convalescent Hospital which is located just across Downriver Drive from Downriver Golf Course.

Public/Semipublic Facilities - Northeast Spokane. Relief sewer construction would occur in streets adjacent to several schools, a branch library, and Holy Family Hospital, the major medical facility in northeast Spokane. As construction would generally affect only portions of the perimeter areas and would not affect major access streets, impacts would be moderate.

Public/Semipublic Facilities - Southwest Spokane. Relief sewer construction would affect the street access to a major downtown fire station and the main access and perimeter of the Rockwood Park Clinic. Other facilities would only be moderately impacted.

Alternative 2 - Satellite Treatment Facilities and Relief Sewers. Treatment facilities and relief sewers would be constructed in the same locations as those proposed for the storage basin and relief sewers (Alternative 1). The only significant difference would be the reduced land area required for satellite treatment facilities. This alternative would require an estimated 9.03 acres for construction of the treatment facilities, with an additional 9 acres required for buffer zones (Gellner, pers. comm.). Length of the construction period at any site would vary, but would average about 6 months (Spokane City Department of Public Works, pers. comm.).

Impacts on adjacent land use would be similar to those described for Alternative 1, but would be of less magnitude. Impacts of relief sewer construction would be identical to those of Alternative 1. As the impact summary for this alternative is essentially the same as for Alternative 1, refer to Tables A-1 through A-5 for impacts by land use category and census tract. The following describes only those impacts which would significantly differ with this alternative from those described for Alternative 1.

Residential - City of Spokane. Due to the reduced land requirements adjacent to residential areas, impacts of treatment facility construction would be correspondingly less. The 2.3 acres required for construction of treatment facility 8B in Peaceful Valley may require removal of some houses, but not to the extent of Alternative 1.

Commercial - City of Spokane. Impacts would be about the same as described for Alternative 1.

Industrial - City of Spokane. Impacts would be the same as those described for Alternative 1.

Parks/Recreation Facilities - City of Spokane. Treatment facilities would require disturbance of significantly less acreage in Riverfront Park, resulting in only moderately adverse impacts on park facilities. Land required at Mission Park and High Bridge Park would also be less, but overall impacts would be generally the same as with Alternative 1.

Public/Semipublic Facilities - City of Spokane. Impacts would be the same as those described for Alternative 1.

Alternative 3 - Separate Storm Sewers. With the exception of undeveloped portions and newer residential areas where separate sewers have been installed most of the city would be affected in varying degrees during the construction phase. Construction would occur in 220 miles of city streets. Three factors would minimize potential long-term construction impacts: 1) the brief nature of construction in any one location; 2) most construction would take place in existing street rights of way; and 3) land affected would be restored to its prior use and appearance upon completion of pipeline construction.

Residential - City of Spokane. Construction would occur on streets adjacent to residential areas throughout much of the city. The primary impacts would be blocked access to homes, traffic obstructions, dust, noise, temporary loss of aesthetics and potential public safety hazards. Construction would involve from one to two blocks of street at any given time for a 1- to 3-week period, and would result in total closure of the streets to through traffic while pipeline placement is underway. There may be some temporary interruption of utility service to homes, generally not to exceed 2 hours (Gellner, pers. comm.). No demolition or relocation of homes would be required to accomplish separate storm sewer construction. See Table A-6 for a summary of residential impacts by census tract.

Residential - Northwest Spokane. Residential areas in much of the northwest portion would be significantly impacted during construction. Most affected would be single-family residential areas, which are the dominant land use in the northwest sector. Multiple-family development, primarily in the west-central portion, would also be significantly impacted. According to a number of indicators, including general condition of structures and average selling price, single-family homes impacted in the northwest quarter would be average or above average for the city. Lower priced and poorer quality housing which would be impacted is primarily located in the older, central city.

Residential - Northeastern Spokane. Construction would take place in most residential areas, with the exception of the easternmost segments. Single-family development would be most significantly impacted. Multiple-family development would be significantly impacted in the area roughly between the Burlington Northern Railroad tracks and the river. In comparison to other areas in the city, the residential development affected is below average in terms of structural condition and selling price.

Residential - Southwest Spokane. Both single-family and multiple-family development would be significantly impacted in southwest Spokane, primarily south of the freeway. Residential areas potentially impacted are generally average and above average in terms of condition and market value.

Residential - Southeast Spokane. Construction impacts would range from significant to moderate in the majority of residential areas. Single-family development would be impacted primarily adjacent to the river and south of Second and east of Grand. Multiple-family development would be most significantly impacted adjacent to the river and between Sprague and Second. Potentially impacted areas vary widely in terms of market value and condition. The area roughly from Mission to 14th Street is generally below average in terms of condition and market value. The more southerly sections range from average and above to the highest range as judged by condition and price.

Commercial - City of Spokane. Construction will occur on streets adjacent to extensive areas of the city's commercial development, adversely impacting some areas (see Employment and Economic Impacts of Construction). Wholesale establishments would be affected to a lesser degree. See Table A-7 for a summary of commercial impacts by census tract.

Commercial - Northwest Spokane. Construction would impact a number of business areas. In the northern portion the most significant impacts are anticipated at the community shopping center at Shadle Park, the strip commercial area on Garland Street, and at the concessions operated at the Downriver Golf Course. Construction would occur along the length of Wellesley Street, which is the main access to Shadle Center, and a small portion of Alberta, which provides north-south access to the center.

The Garland strip commercial segment would experience construction impacts along its entire length. All major access streets to Downriver Golf Course will be affected by construction, as will the clubhouse and pro shop. Construction will occur next to a number of neighborhood businesses, with the more significant impacts along Ash Street.

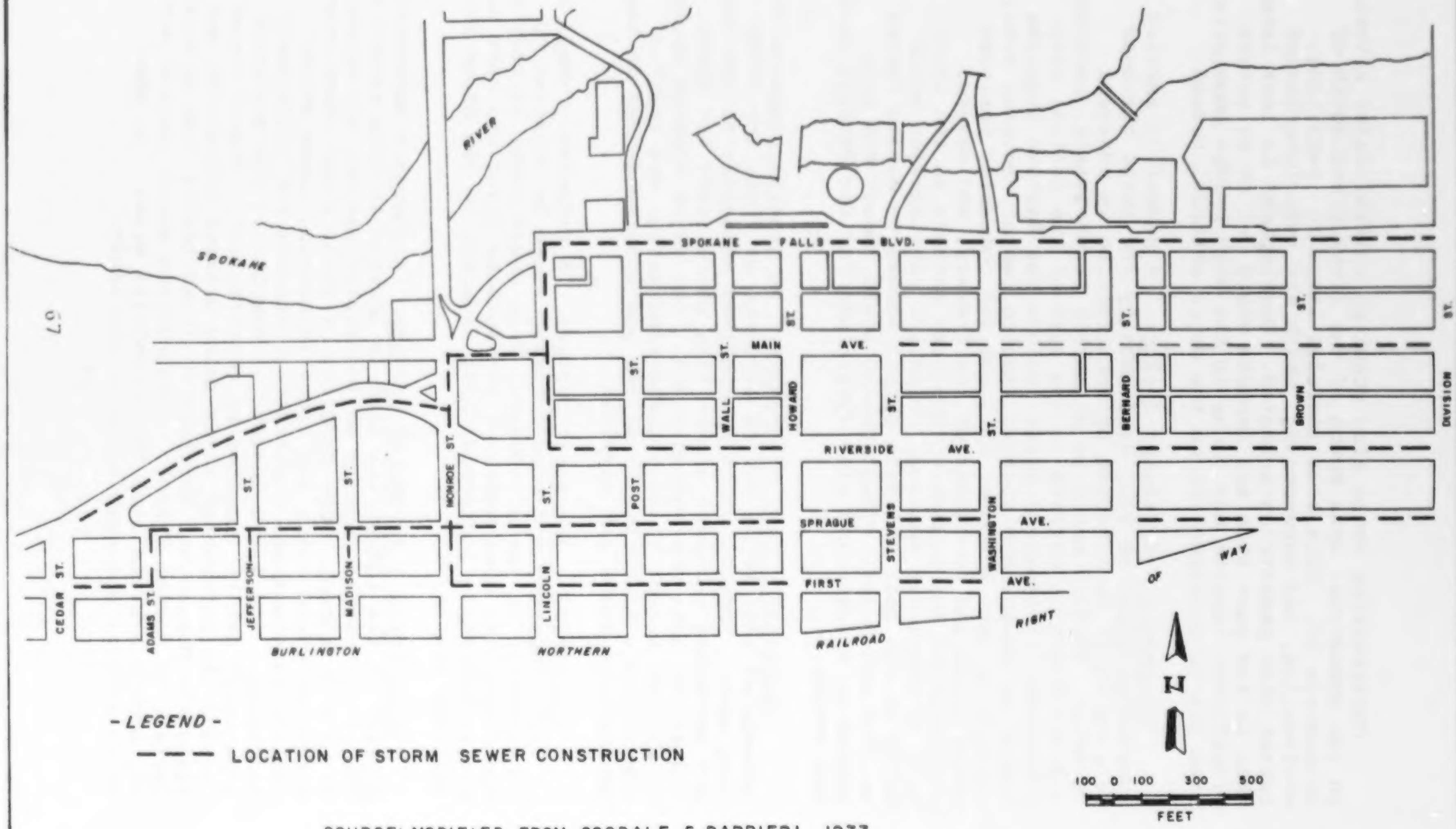
The commercial area potentially impacted in the central portion of Spokane is a combination of business services, wholesaling and warehouses, light industry, and long-term parking. Most of the establishments are housed in older buildings, and there has been considerable demolition in recent years as older and empty structures have been cleared for surface parking or other uses.

Commercial - Northeast Spokane. Neither of the two major commercial areas located along Division and Market Streets would be significantly affected by construction. Several small neighborhood commercial areas would be moderately impacted by construction. Overall, impacts on commercial uses in northeast Spokane would be minimal.

Commercial - Southwest Spokane. The most significant impacts would occur in the southwest sector due to the extensive construction planned in the central business district and the adjoining wholesale and commercial areas. Figure 4-2 shows construction proposed in the downtown area. Construction activities would be most disruptive in the core area which extends between Washington Street, the Burlington Northern Railroad, Monroe Street, and Spokane Falls Boulevard. All east-west thoroughfares would undergo separate storm sewer construction as would the major access on Monroe Street. The system of overhead skywalks would somewhat relieve the disruptive effects of construction on pedestrian traffic. However, construction would occur adjacent to several of the major downtown parking facilities, compounding traffic congestion problems.

FIGURE 4-2

STORM SEWER CONSTRUCTION PLANNED IN SPOKANE CBD AS PART OF ALTERNATIVE 3


SPOKANE
RIVER
SPOKANE FALLS BLVD.
MAIN AVE.
RIVERSIDE AVE.
SPRAGUE AVE.
FIRST AVE.
CEDAR ST.
ADAMS ST.
JEFFERSON ST.
MADISON ST.
MONROE ST.
LINCOLN ST.
POST ST.
WALL ST.
HOWARD ST.
STEVENS ST.
WASHINGTON ST.
BERNARD ST.
BROWN ST.
DIVISION ST.
BURLINGTON NORTHERN RAILROAD RIGHT OF WAY
N
100 0 100 300 500
FEET
- LEGEND -
LOCATION OF STORM SEWER CONSTRUCTION

SOURCE: MODIFIED FROM GOODALE & BARBIERI, 1977

Construction would also occur on several major arterials in the commercial area south of the freeway and north of Interstate 90. This area includes large lot retailing, wholesaling, and warehousing, which are vehicle-oriented rather than pedestrian-oriented. Development is less intense than in the core area and impacts would not be as severe. Significant impacts may occur in the High Bridge commercial area due to construction on the major arterial access.

Commercial - Southeast Spokane. A number of service commercial areas as well as community and local business centers would be affected by construction in adjacent streets. Impacts would be primarily on wholesale, warehousing, and distribution outlets to the east of the central city. Significantly impacted areas include the Eastown Shopping Center at Havana and Sprague, Manito Center, several retail centers on 1st, a number of local and community business zones south and southeast of the freeway, and several neighborhood and community business centers in the lower half of southeast Spokane. Pipeline construction would occur on the main and side street access to Manito Center on 29th and Grand. Construction would impact the main access on Sprague and also Myrtle and Pacific Streets bordering the center.

Industrial - City of Spokane. In general, impacts on industrial uses would not be as great as those for other land uses. Impacts would be confined primarily to the east and northeast sections of the city where light and heavy industrial uses are concentrated. The major impacts would be blocked access to some industrial areas, and traffic obstructions resulting in delays and inconveniences in the movement of goods and supplies.

Industrial - Northwest Spokane. A relatively small amount of light industry and manufacturing would be impacted by construction in the northwest. This would occur largely in the commercial area north of the Spokane River and core area and in Ash-Maple industrial area adjacent to the Union Pacific Railroad tracks.

Industrial - Northeast Spokane. Although a substantial portion of the industrial land is located in this sector of the city, overall impacts on industrial use are not expected to be significant. The majority of those areas where construction would occur are light industrial zones which include warehousing, distribution centers and light manufacturing. The large industrial complex in the Hillyard area would not be impacted by construction. Impact areas include the industrial zones below Gonzaga University and along the Burlington Northern Railroad tracks from approximately Mayfair to Market Street. Construction would involve several key access streets into the industrial areas. In most cases alternate access would be available.

Industrial - Southwest Spokane. Only isolated industrial uses in the downtown area would be affected by construction. Areas affected would experience minor to moderate impacts.

Industrial - Southeast Spokane. The most extensive impacts on industrial uses would occur in the southeast sector due to construction planned throughout much of the industrial zone extending from Division to the city limits. It is anticipated that a major impact area would be the light industrial zone east of Division. Construction would occur in major arterials serving the warehouse and distribution sectors. Traffic obstructions could also be expected along Trent, which is a major arterial serving the entire eastern industrial area. Construction would occur adjacent to the 6-acre Hanson Industrial Park on Trent, which is planned for offices and warehouses and the Trumark Industrial Park, on Havana and Sprague, which is planned for light manufacturing. Table A-8 summarizes industrial impacts of Alternative 3.

Parks/Recreation Facilities - City of Spokane. Construction would occur in city streets bordering many of the city's most intensively used parks, as well as next to many popular neighborhood parks. Many of the parks have little or no screening to buffer them from adjacent streets. The severity of construction impacts would depend on a number of factors including the extent to which major access streets and parking are obstructed, the type and degree of existing recreation use, and the timing of construction activities.

During construction, noise, dust and potential hazards posed by heavy equipment in close proximity to children's play areas, may significantly reduce park use. Adverse impacts will be compounded should construction occur during the peak summer period. According to the City Parks Recreation Director, impacts would not be as substantial in the large parks where recreation use is more dispersed and facilities are a greater distance from city streets. The Director also anticipates lesser impacts in the community parks, which emphasize organized team sports due to the overriding importance of game schedules, etc. (Fearn, pers. comm.). Table A-9 summarizes park impacts by census tract and the following describes impacts in the four sections of the city.

Parks/Recreation Facilities - Northwest Spokane. Construction will take place on major access streets and the perimeters of Franklin Park, Shadle Park, Clark Playground, A. M. Cannon and Riverfront Parks. In many cases access to parking lots would be obstructed. Activities such as picnicking, tennis and utilization of playground facilities could be expected to decline during the construction phase. Both pedestrian and vehicular traffic to the northshore of Riverfront Park would be temporarily obstructed during construction. On-street parking and several parking lots in the vicinity of the park may also be temporarily closed off during construction, exacerbating the existing shortage of parking during peak use periods. Use in the park may also be reduced due to noise and dust factors previously mentioned (see Parks - Southwest Spokane for additional discussion).

The other major impact area will be Downriver Golf Course. All major access streets to the course would have pipeline construction. Construction would also temporarily block access to the clubhouse and parking lot. The golf course manager indicated a potentially significant impact if access to the clubhouse and parking is blocked during the peak summer season (Korff, pers. comm.).

Parks/Recreation Facilities - Northeast Spokane. With the exception of the large Esmerelda Golf Course and Minnehaha Park, all park areas in northeastern Spokane would be affected in varying degrees by pipeline construction. Most parks would have at least one main access road where no construction is planned, therefore, reducing potential construction impacts. However, general recreation use can be expected to decline during construction. The most significant impacts are expected at Mission Park. Construction would occur around much of the park perimeter, including the main access on heavily travelled Mission Street. The increased traffic congestion due to equipment working in the area, and proximity of swimming, tennis and picnic facilities to construction areas, may substantially reduce use at the site.

Parks/Recreation Facilities - Southwest Spokane. Construction would impact several of the largest parks and recreation areas in the city. Construction would occur on major access roads into Riverfront, High Bridge, Cannon Hill, Comstock, and Manito Parks. Construction would also occur around all or portions of the park perimeters. The most significant impacts are expected to result from construction along the length of Spokane Falls Boulevard bordering Riverfront Park and construction on Riverside and Monroe leading to and from the park. Access to on- and off-street parking would be reduced. The grassy areas bordering Spokane Falls Boulevard are extensively used for picnicking and open air entertainment. Such uses would decrease substantially with the noise, dust, etc., caused by pipeline construction. Construction may also decrease use at the carousel and opera house, primarily due to reduced availability of nearby parking. Current attendance on weekdays during the summer season is 5,000 to 6,000, which often swells to 25,000 daily on the weekends (Fearn, pers. comm.).

Parks/Recreation Facilities - Southeast Spokane. Due to construction on major access roads and perimeter streets, significant impacts may be expected at Chief Garry Park, Underhill Park, Lincoln Heights Park, and Hamblen Park. At all four locations construction would take place adjacent to developed facilities, potentially decreasing use due to such nuisance factors as noise and dust and possible safety hazards.

Public/Semipublic Facilities - City of Spokane. Of the alternatives considered, separate storm sewers construction would have the most significant impacts on public facilities. Thirty of the 48 schools within the city limits would experience varying degrees of construction-related impacts.

Should construction take place while schools are in session, a major short-term impact would be construction activities occurring in close proximity to school facilities and playgrounds. Adverse impacts would include noise, dust, distraction, and associated nuisance problems for school personnel and students. Operation of construction equipment could also pose potential safety problems, particularly for the younger students. Construction at some of the more significantly impacted schools would also temporarily impede bus and private auto transport of students.

As the majority of construction workers are expected to be from the local area, no significant increase in student enrollment would occur due to families of the workers moving into the area.

Construction would also occur adjacent to a number of major hospitals. Primary impacts would include construction on main access streets and streets used as emergency and ambulance entrances, and increased noise. Impacts on other public and semipublic buildings would be primarily short-term obstructions to traffic flow to and from buildings and reduction of nearby parking spaces.

Table A-10 is a summary of impacts on public/semipublic facilities by census tract, and the following describes impacts in the four sections of the city.

Public/Semipublic Facilities - Northwest Spokane. Construction would occur on the main access and student loading zones of a number of the public schools, requiring rerouting of bus and automobile traffic to the schools. Construction would occur adjacent to the main entrance to the Shriners Hospital for Crippled Children, causing both noise and traffic problems. A number of public buildings in the central area would be affected. The most significantly impacted would be the Coliseum and Civic Theater due to construction planned on Howard Street, which is the major entry to these facilities.

Public/Semipublic Facilities - Northeast Spokane. The majority of public and private educational facilities in northeast Spokane would be impacted to some degree by construction. Student loading zones and main school access may be obstructed at several of the schools. Construction would be required on the main access and emergency and ambulance entrance to Holy Family Hospital.

Public/Semipublic Facilities - Southwest Spokane. Construction would occur next to a number of public and semipublic buildings in the core area. This would include the institutional and semipublic buildings on Riverside west of Monroe, City Hall, and the cultural and entertainment facilities on Spokane Falls Boulevard in Riverfront Park. As there is currently heavy traffic to and from these facilities and limited parking, traffic obstructions and decreased on-street parking would have a significant impact, particularly for recreation and cultural facilities.

Access to and from the Burlington Northern Station may be obstructed due to construction on Sprague. Hospitals and related facilities in the medical center to the south of the downtown area would also be affected by construction. Construction would be required on the streets providing admitting and emergency entrance to Deaconess Hospital and the main entrance to Rockwood Park Clinic. Construction would also occur adjacent to Sacred Heart and St. Lukes Hospitals. In varying degrees, all of these hospitals would be adversely impacted by the resulting noise, traffic problems, and obstruction of parking areas.

Public/Semipublic Facilities - Southeast Spokane. Construction would occur on the main access streets and student loading zones of several schools. The only other major facility affected would be the Playfair Race Track due to construction on Regal and Sprague.

Klicker Storage Suboption. The Klicker storage option would require construction activity quite similar to that described for Alternative 1 with a few notable exceptions. Instead of constructing 14 large underground storage facilities with 25-year storm capacity, Klicker's Plan calls for smaller 5-year storm capacity underground storage basins and adjacent surface lagoons capable of handling all expected overflows beyond the 5-year storm. The land area required for this dual basin concept would be larger than that needed for the city's storage plan. Klicker's Plan also calls for a large reservoir south of Bridge Street roughly between Cannon and Lindeke. This facility would drastically reduce the size of the underground facility planned by the city near Rivercrest Convalescent Hospital (basin 16B).

The expanded size of the Klicker storage facilities would mean that construction activity would displace and disrupt more existing land uses than described for Alternative 1. This would be especially significant in the more confined, urbanized storage basin sites (13B, 8B, 7B, 6B, 5B, and 4B). The large Bridge Street reservoir would not displace any significant existing land use, but would preclude the future residential use proposed in the city's Shoreline Master Plan.

The Klicker Plan does not include construction of relief sewers. Instead, check valves and small storage basins would be built on each piece of property with sewer backup problems. The exact number of properties affected is not known, but construction would probably be confined to off-street locations adjacent to the affected dwellings. Mr. Klicker estimated 700 structures would be involved. This on-site construction would be of short duration and probably would not disrupt access or traffic, but noise, dust and general nuisance conditions would be significant for those residences involved.

Latenser Plan. The Latenser Plan is a modification of Alternative 1 and therefore would produce some of the same construction impacts. Relief sewer construction would be just as described for Alternative 1. Storage basins 1B through 8B and 16B would all be eliminated in favor of various combinations of separate sewer construction and pumping to underutilized interceptors. New pump stations would be needed at Erie Street and Clarke Street. In addition, a 110-inch pipeline would be constructed across Fort Wright Bridge and through Riverside State Park to a 50-million-gallon storage reservoir across the river from the treatment plant.

The land use disruptions associated with construction of the city's storage basins would be precluded, but in its place pipeline construction would create a significant short-term visual disturbance through Riverside State Parks open space. It might also require removal of trees and shoreline vegetation from Fort Wright Bridge to the proposed storage site (see Figure 2-6). The storage basin itself would be constructed in an open, relatively undisturbed setting planned for continued park use. The site is highly visible from Government Way on the south side of the river and the residential area above the treatment plant on the north side of the river.

Specific locations have not been identified for the wastewater export facilities required for the Latenser Plan. They would include 1) a 3-mile pipeline across open space and agricultural land from the 50 million-gallon storage site to the Lyons area, 2) a 1 billion-gallon storage reservoir in open space/agricultural land near Lyons, 3) an 18-mile pipeline through agricultural land from Lyons to the headwaters of Crab Creek, and 4) a storage facility in agricultural land near Odessa. Construction of these facilities would disrupt or displace agricultural operations. Dry-farming of wheat is the predominant agricultural use in the areas involved.

The Combination Concept. The combination alternative would require storage basin and relief sewer construction in some parts of the city and separate sewer construction in the others. The impacts of project construction would therefore be a combination of the impacts described earlier for Alternatives 1 and 3. Figure 2-7 indicates which basins would receive separate sewers and which would receive storage basins. A brief summary of the more significant of these impacts is presented below.

Sewer separation would occur in basin drainage areas 1, 2, 3, 4, 7, 9, 11 and 13. These are the smaller drainage areas bordering the river both east and west of the main downtown commercial area. Therefore, commercial disruptions would not be major, but some of the city's older residential neighborhoods and most of the heavy industrial areas would be affected by street construction. Downriver, Chief Garry and Mission Parks would also be impacted by the separate sewer construction. None of the city's major shopping centers would be affected.

Drainage areas 5, 6, 8, 10, 12, 14 and 15 would be served by underground storage facilities and relief sewers. The storage basins at Riverfront Park (6B), Peaceful Valley (8B), Northwest Boulevard (14B) and Riverton Drive (3B) have the most significant short-term construction impacts associated with them. Recreational disruptions would occur at the golf course and Riverfront Park, while residential impacts are the most significant in Peaceful Valley and on Northwest Boulevard and Riverton Drive. More specific descriptions of the impacts of these storage and pipeline facilities can be found in the sections dealing with Alternative 1 and Alternative 3 construction.

No-Action. As this alternative would require no construction, there would be no impacts on land use. For long-term impacts of this alternative see Long-Term Effect of New Facilities on Adjacent Land Uses.

Mitigation Measures for Construction Impacts on Land Use and Development.

Residential Impacts. As residential streets would be closed to all through traffic while under construction, alternate access must be maintained for residents of affected areas. Construction should be limited to a maximum of two contiguous blocks at one time, with completion required before work commences on the next section of street. Residents of areas where work is planned would be given ample notice prior to the start of construction (Gellner, pers. comm.). The contractor should be required to designate a project coordinator to handle special problems in residential areas such as utility disruptions, noise and dust. Repair of damage to surface improvements on private property, such as fences, walks, trees, shrubs, and flowers would be the responsibility of the contractor (Spokane City Department of Public Works, n.d.). Construction should be limited to daylight hours of normal working days. (Also see discussion of mitigation for impacts on noise, dust, public safety, aesthetic, and population dislocation).

Commercial Impacts. Mitigation measures are discussed under Employment and Economic Impacts of Construction.

Parks and Recreation Facilities Impacts To the extent feasible, construction should be planned in the off-season from September through March when recreation use would be lowest. Where construction would occur adjacent to intensively used facilities, temporary barriers should be constructed. Construction should be programmed to avoid work at parks during periods when major public events are planned. Alternate access to major parks should be provided at all times. Due to potential impacts on Riverfront Park and Downriver Golf Course, coordination should be maintained with city park personnel to determine methods of reducing adverse impacts. Consideration should be given to providing substitute parking areas during construction for these two facilities. Should the satellite treatment plan be selected, an alternative location to the Riverfront Park site should be investigated due to the potential impacts previously discussed. (Also see discussion of mitigation for noise, dust, public safety and aesthetic impacts).

Public/Semipublic Facilities Impacts. To the extent possible, construction adjacent to school facilities should be carried out during the summer months. In those streets providing emergency and ambulance entrances to hospitals, at least one lane should remain open at all times, and construction should be limited to daylight hours. Alternate access to major public facilities should be provided at all times. Consideration should also be given to providing temporary replacement parking areas for public facilities in the downtown area. (Also, see discussion of mitigation for impacts on noise and dust.)

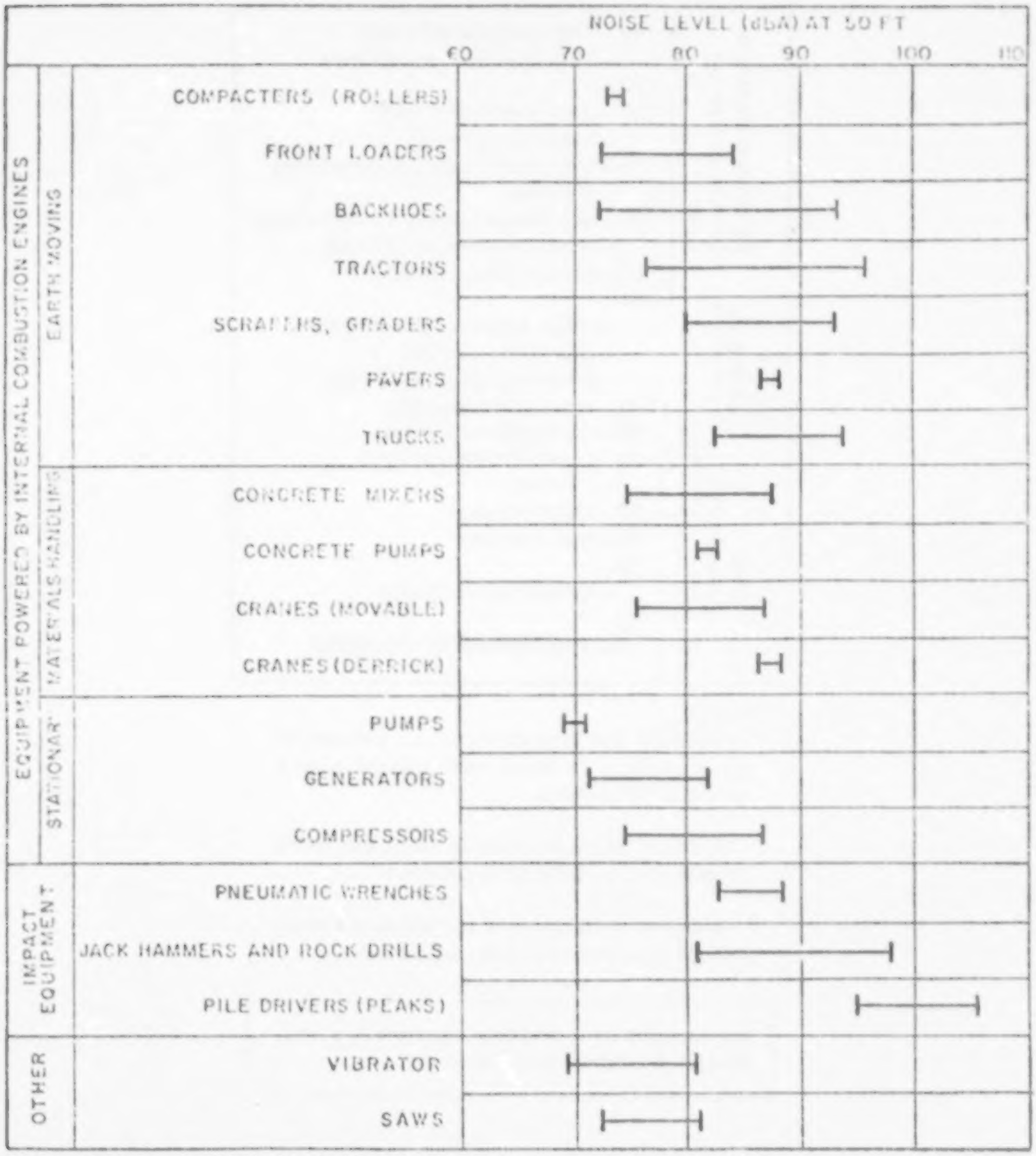
Noise

According to an environmental analysis by the city, transportation systems (both vehicular and rail) are the dominant noise producers in the city. Chief problem areas include 1) northwest Spokane where noise, particularly along major arterials, often interferes with normal residential areas, 2) the Felts Field area, 3) areas along major railroad lines, 4) arterials in the east central area, and 5) some portions of the southwest (Spokane City Plan Commission, 1976a). Noise levels of above 67 dBA represent the beginning of residential conflicts, with serious problems at 72 dBA. Interference with normal activities in school classrooms are also noted when levels reach 72 dBA. Commercial and office environments are generally compatible with levels up to 77-79 dBA. Noise in excess of this is acceptable only in industrial environments where hearing protection can be provided and in open space areas where human existence is only sporadic and temporary (Spokane City Plan Commission, 1976a). The city currently has no noise ordinance but is in the process of drafting regulations. The State of Washington Environmental Noise Control Ordinance restricts all noise sources in residential areas between 10:00 p.m. and 7:00 a.m. Most heavy construction noise would be unacceptable during these hours. Construction will typically extend from 7:00 a.m. to 4:30 p.m. during the weekdays, with no work generally occurring on weekends (Gellner, pers. comm.). Noise due to separate storm sewer construction (Alternative 3) would affect a larger area of the city, but would be of a shorter duration at any one location compared to the other two city alternatives (Alternatives 1 and 2). Figure 4-3 gives construction equipment noise ranges and Table 4-1 gives sound levels of noise sources most people have been exposed to at one time or another.

Alternative 1 - Storage Basins and Relief Sewers. Equipment required for storage basin construction would include heavy earth-moving equipment and materials handling equipment such as concrete mixers and cranes. Heavy trucks would move equipment in and out of the site. Equipment for relief sewer construction would be the same as that described in Alternative 3. See Figure 4-3 for typical noise levels generated. Noise levels would be higher and more prolonged at basin construction sites than would occur with any segment of separate storm sewer construction.

Figure 4-3

CONSTRUCTION EQUIPMENT NOISE LEVELS

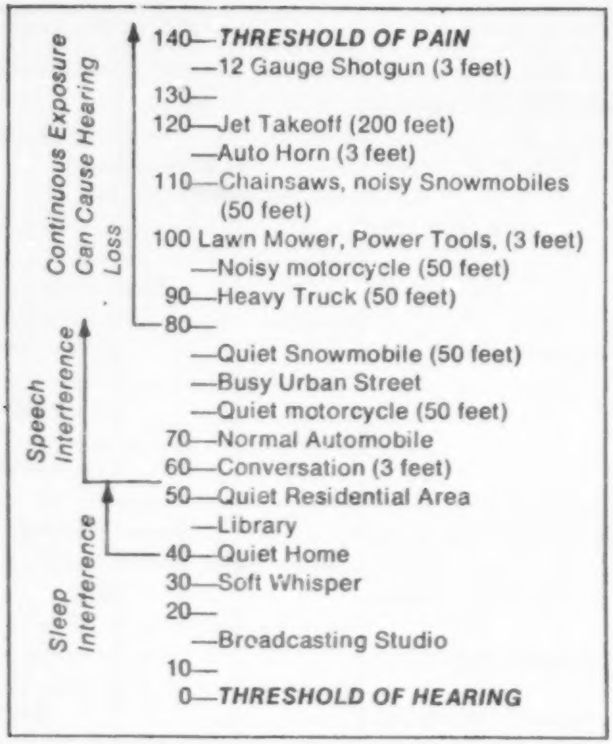


Note: Based on Limited Available Data Samples

Source: U. S. Environmental Protection Agency, 1971.

Table 4-1

TYPICAL SOUND LEVELS



140—**_THRESHOLD OF PAIN_**
—12 Gauge Shotgun (3 feet)
130—
120—Jet Takeoff (200 feet)
—Auto Horn (3 feet)
110—Chainsaws, noisy Snowmobiles (50 feet)
100 Lawn Mower, Power Tools, (3 feet)
—Noisy motorcycle (50 feet)
90—Heavy Truck (50 feet)
80—
—Quiet Snowmobile (50 feet)
—Busy Urban Street
—Quiet motorcycle (50 feet)
70—Normal Automobile
60—Conversation (3 feet)
50—Quiet Residential Area
—Library
40—Quiet Home
30—Soft Whisper
20—
—Broadcasting Studio
10—
0—**_THRESHOLD OF HEARING_**

NOTE:

Decibels are logarithmic—i.e., a sound of 50 decibels is *10 times* more intense than a sound of 40 decibels.

A sound of 60 decibels is *100 times* more intense than a sound of 40 decibels.

A sound of 70 decibels is *1000 times* more intense than a sound of 40 decibels, etc.

An increase of 3 decibels represents a *doubling* of the intensity of the sound.

SOURCE: Washington Department of Ecology, n.d.

In areas where storage basins are planned in undeveloped park areas, vacant and sparsely developed residential areas, and industrial areas, noise impacts would be greatly reduced. The most significant impacts would occur where storage basins are planned in street rights-of-way adjacent to residential areas and within developed recreation areas. Construction of storage basin 16B would have a significant short-term noise impact on the Rivercrest Convalescent Hospital. Noise impacts due to relief sewer construction would be similar to Alternative 3, but would affect a lesser area.

Alternative 2 - Satellite Treatment Facilities. Construction equipment would be similar to that required for Alternatives 1 and 3. As the areas to be excavated would be smaller, less heavy earth-moving equipment would be required and construction would occur over a shorter period. Noise impacts would, therefore, be less overall than with either Alternatives 1 or 3. See Tables A-1 through A-5 for a listing of developments impacted.

Alternative 3 - Separate Storm Sewers. Construction would involve use of jackhammers and in some locations rock drills, backhoes, compactors, graders and pavers, heavy trucks to deliver construction materials, and pickups (see Figure 4-3 for noise generated). Blasting would occur in some areas where solid rock excavation is required. This would occur primarily in the southeast portion, the northern portion of the downtown area and a portion of the southwest. Noise problems would be most severe for hospitals and schools located adjacent to construction zones. High noise levels would also cause nuisance problems in residential areas. Increased noise can be expected to discourage daytime recreation use at a number of the city's more significantly impacted recreation and entertainment centers. Noise may also interfere with normal business activity in the commercial and office zones where construction would be extensive. See Tables A-6 through A-10, for a listing of developments impacted.

Klicker Suboption. Construction noise under this option would be essentially the same as described for Alternative 1. Construction at storage site 16B would be greatly reduced. This would be replaced by construction of a large surface reservoir below Bridge Street. Construction noise in this area would affect the residential area to the north.

Latenser Plan. This plan would eliminate most downtown storage basin construction in favor of more pipeline and pump station construction. Associated noise would therefore be reduced. In outlying areas, however, the construction-related noise would be much greater. Pipeline and storage basin construction in Riverside State Park south of the river would be disruptive to the present open space-recreational uses of the land. Construction of the remaining export facilities would occur in sparsely populated areas, thereby having a minimal effect.

Combination Concept. The major construction noise impacts created by the combination alternative would occur at storage basin sites in Riverfront Park and in residential areas on Northwest Boulevard, in Peaceful Valley and adjacent to Downriver Golf Course. Separate sewer and relief sewer construction would cause a combination of short-term noise impacts described for Alternatives 1 and 3.

No-Action. As no construction would be required, existing noise conditions would remain unchanged.

Mitigation Measures. The greatest potential for noise abatement for all equipment powered by internal combustion engines lies in use of better exhaust mufflers, intake silencers, and engine enclosures. Reductions of 5 to 10 dBA are common (U. S. Environmental Protection Agency, 1971). Abatement of noise associated with impact tools such as jackhammers and pavement breakers is difficult to achieve. Abatement could best be accomplished by substituting use of a sonic (vibratory) pile driver for an impact machine wherever possible. A slight decrease may be achieved by use of acoustical barriers enclosing the work area. Other potential noise abatement measures would include scheduling of equipment operations to have noisiest operations coincide with times of highest ambient levels and restricting construction activities to daylight hours in residential areas. Keeping noisy equipment as far as possible from site boundaries, and providing enclosures for stationary items of equipment can also be effective in reducing noise levels. Barriers would be most feasible surrounding storage basin work zones in developed areas. Due to the brief nature of street construction in any one location, barriers would not generally be warranted except in extreme cases such as areas adjacent to hospitals and schools.

Public Safety

Alternative 1 - Storage Basins and Relief Sewers. Public safety hazards would be greatest where construction is planned in streets adjacent to residential areas, and within the Peaceful Valley residential development. Hazards would be primarily due to operation of large construction equipment and the deep excavated area which would be temporarily left open. Due to the intensive use at Riverfront Park, excavation of the large storage basin planned within the park would constitute a potentially serious public safety hazard. Construction of a storage basin at Mission Park could also pose significant problems due to the movement of equipment in and out of the site onto congested Mission Boulevard and the proximity of the construction site to recreation facilities. Impacts of relief sewer construction would be similar to those described for Alternative 3, but would be less severe due to the more limited areas involved.

Alternative 2 - Satellite Treatment Plants and Relief Sewers. Public safety impacts would be similar to those described for Alternatives 1 and 3 but would be of less magnitude due to the smaller construction areas involved and the shorter construction period required for completion of each unit. The completed facilities would pose a greater long-term public safety risk due to the required chlorination facilities.

Alternative 3 - Separate Storm Sewers. Public safety would be most affected by the storm sewer alternative due to the extent of populated areas and traffic corridors impacted. Operation of construction equipment adjacent to residential areas and parks and schools could pose a public safety hazard. During the excavation phase, open trenches could be dangerous if adequate barriers and warning signs are not provided. Blocking off of streets and rerouting of traffic may confuse motorists and compound congestion, increasing the incidence of traffic accidents. Traffic delays could increase response time of emergency equipment such as fire trucks, ambulances, and police vehicles. Emergency and ambulance entrances to several major hopsitals would be partially closed during construction. Blasting in populated areas could pose a significant safety problem if adequate precautions were not taken.

Klicker Suboption. Public safety hazards created by the Klicker storage plan would be essentially the same as those for the city's Alternative 1. Construction of the Bridge Street reservoir would reduce construction at basin 16B. This should make no major difference in public safety hazard. The open surface lagoons of the Klicker Plan would require fencing to eliminate a long-term hazard to anyone entering the premises.

Latenser Plan. The Latenser Plan would include construction of relief sewers as described for Alternative 1. Most of the storage basin construction required in the city's storage alternative would be eliminated. This would reduce downtown public safety problems significantly. The downtown construction would be replaced by less hazardous activity south of the river in Riverside State Park, and in open areas from Spokane to the headwaters of Crab Creek.

No-Action. As no construction is involved in no-action, public safety conditions would remain the same as present conditions.

Mitigation Measures. Temporary barriers should be required around all storage basin and satellite treatment excavation areas. Barriers or covers should be required for the open trenches that would exist temporarily with separate storm sewer or relief sewer construction. Daily backfilling of excavated trenches could keep the need for barriers and covers to a minimum and is undoubtedly the most effective means of reducing safety hazards during the pipe-laying process. Barriers should also be considered between work zones and adjacent elementary schools (if in session) and park facilities. Construction zones should be clearly marked by warning signs and other cautionary devices. Traffic problems could be substantially reduced by programming of work to avoid rush hour traffic on major arterials, clear and adequate advance notice of detours, nighttime construction on the most heavily travelled thoroughfares, and advance notice in the media of location and timing of work planned on major streets. In high risk areas such as school zones, playgrounds and parks, and areas where blasting is planned, the contractor should be required to provide additional personnel to monitor construction activities and implement public safety procedures. Chlorine storage facilities for satellite treatment plants should be completely secured by adequate fencing and any other measures required to restrict unauthorized access. The use of hypochlorite for disinfection rather than chlorine gas could eliminate this public safety hazard.

Aesthetics

Alternative 1 - Storage Basins and Relief Sewer. Impacts of relief sewer construction would be similar to Alternative 3, but would have a significant impact only on a portion of scenic drives on Northwest Boulevard, 21st Avenue and Rockwood Boulevard, and the residential and park areas impacted. Construction of a number of the storage basins would cause a more serious short-term decline of aesthetics due to the large-scale excavation required in parks and scenic areas and the high visibility of construction work from several major view areas. To the extent possible, work areas would be restored to their prior state, but some long-term adverse impacts are unavoidable. Table 4-2 summarizes existing aesthetic conditions and anticipated impacts at the storage basin sites.

Alternative 2 - Satellite Treatment and Relief Sewers. Impacts would be the same type as those described for Alternatives 1 and 3, but would be of less magnitude due to the smaller land areas disturbed.

Alternative 3 - Separate Storm Sewers. Construction would result in a temporary loss of aesthetics due to street work, presence of construction equipment, possible disturbance or removal of some landscaping bordering streets, and creation of dust, and noise. The most adverse short-term effects would occur at Riverfront Park on scenic drives and arterial parkways including Manito Boulevard, Rockwood Boulevard, 21st Avenue, High Drive Parkway, Summit Boulevard, and Riverview Drive adjoining the Downriver Golf Course and on Riverside in the unique architectural section west of Monroe. A reduction in visual quality would also occur in residential areas and adjacent to the many parks where construction is planned. Upon completion of construction, work areas would be restored to their original condition, minimizing long-term aesthetic losses.

Klicker Suboption. Construction-related aesthetic impacts of the Klicker Plan would be similar to those of Alternative 1. The size of the area affected by storage basin construction would be slightly larger for the Klicker Plan. Added detractions would be especially noticeable in Riverfront Park (basin 6B), at Downriver Golf Course (13B), in Peaceful Valley (8B), along Hangman Creek at High Drive Park (9B), and on Northwest Boulevard (14B), near the treatment plant site. The aesthetic problems associated with surface storage construction would be long-term at all storage basin locations unless considerable site landscaping and/or screening was made part of the project. The proposed open basins would not be aesthetically compatible in residential or recreational settings, especially when they were filled with untreated CSO. It is expected that the open basins would be used once every 5 years on the average.

Table 4-2

CONSTRUCTION-RELATED AESTHETIC IMPACT SUMMARY (Alternative 1)

Storage Basin	Existing Use	Adjacent Use	Aesthetic Quality of Site	Anticipated Impacts	Duration of Impact	Severity of Impact
1B	Vacant	Industrial	Low	None	-	None
2B	Vacant	Residential/ Spokane River	Moderate	Reduced aesthetics in residential area-Will affect view from river	Short-term	Moderate
3B	Street	Residential/ Spokane River	Moderate	Reduced aesthetics in residential area-Will affect view from river	Short-term	Moderate
4B	Parking lot	Mission Park	Low	Reduced aesthetics at Mission Park	Short-term	Moderate
5B(1)	Brickyard	Industrial	Low	None	-	None
5B(2)	Vacant	Industrial	Low	None	-	None
6B(1)	Parking lot	Riverfront Park	Moderate	Will affect view from opposite bank and and Washington Bridge	Short-term	Moderate
6B(2)	Park	Riverfront Park	Moderate to High	Will affect views from adjoining park areas and Washington Bridge-Remove landscaping	Short-term	Significant
7B	Vacant	Commercial public facility	Low	None	-	None
8B	Residential	Residential/ Spokane River	Moderate to High	Remove homes of architectural/historical interest-Degrade major view area in city-Will affect view from river, Monroe Bridge, and Gondolas	Long-term	Significant
9B	Meadow	Forest/ Inland Empire Highway	High	Remove vegetation-Disturb open space area-Will affect view from Highway and High Drive	Long-term	Significant

Storage Basin	Existing Use	Adjacent Use	Aesthetic Quality of Site	Anticipated Impacts	Duration of Impact	Severity of Impact
10B	Park	Park/Hangman Creek	High	Remove vegetation-Disturb open space area-will affect view from opposite bank	Long-term	Significant
11B	Street	Abandoned railroad grade-limited residential	Low	None		None
13B	Intersection 12th Tee	Residential/golf course clubhouse/pro shop	Moderate	Reduced aesthetics in residential area-Golf course	Short-term	Moderate
14B	Street and vacant	Residential/Spokane River	High	Reduced aesthetics in scenic drive and in residential area-Will affect view from river	Short-term	Significant
16B	Park	River, Convalescent Hospital, Golf Course	High	Remove vegetation-disturb open space area-will affect view from river and Downriver Drive.	Long-term	Significant

Latenser Plan. Construction of Latenser Plan facilities would create aesthetic detractions primarily in Riverside State Park from Fort Wright Bridge to the proposed storage basin across the river from the city treatment plant. Pipeline excavation along the south bank of the river would be especially deleterious to the relatively undisturbed open space character of this part of the park. The presence of heavy equipment and excavation spoil in the parkland will be noticeable from numerous vantage points on both sides of the river.

Export system construction from the treatment plant site to upper Crab Creek would occur through relatively open terrain. Where pipeline and storage basin construction bordered major roadways, the activity could be considered a detraction to passing motorists. Specific locations for these facilities have not been determined.

Combination Concept. This option would require storage basin construction at sites 5B, 6B, 8B, 10B, 14B and 16B. The aesthetic implications of construction at these sites are listed in Table 4-2. Separate sewer construction would occur mostly in older residential neighborhoods and industrial areas adjacent to the Spokane River. Scenic Riverview Drive adjacent to Downriver Golf Course would be affected, as would High Drive Parkway near Manito Golf Club and Summit Boulevard south of Maxwell.

Mitigation Measures. Surface restoration and landscaping should be required where basin and treatment plant construction disturbs the terrain. To the extent possible, structures should be sited to avoid removal of mature trees. Where permanent structures such as treatment plant storage facilities or surface lagoons would be visible, landscaping in keeping with the surrounding terrain should be required. Long-term adverse aesthetic impacts of storm and relief sewer construction should be largely mitigated by protective and restorative measures required as part of the construction contract. Where construction is planned on heavily landscaped streets and scenic drives and parkways, trenches should be shored, not sloped. This would limit disruption of vegetation, sidewalks, etc.

Population Dislocation

Alternative 1 - Storage Basins and Relief Sewers. The construction of storage basin 8B (Peaceful Valley), may require some permanent removal of housing. Peaceful Valley is one of the two lowest income sections of the city. The area has a high number of elderly and disabled residents who live on fixed incomes (Spokane City Plan Commission, 1974). Dislocation of such persons may have a serious psychological and economic impact due to difficulties in adjusting to a new place of residence and securing replacement housing which would be affordable.

Alternative 2 - Satellite Treatment and Relief Sewers. Although the land required at site 8B would be significantly less than with Alternative 1, some housing may be removed. Impacts would be the same as those previously described.

Alternative 3 - Separate Storm Sewers. Construction would not result in any population displacement.

Klicker Suboption. The Klicker storage suboption would require essentially the same population dislocations as described for Alternative 1. There could be additional houses removed in the Peaceful Valley area, depending upon the location of the surface lagoon adjacent to basin 8B.

Latenser Plan. Because the Latenser Plan does not require major storage basin construction in downtown Spokane, it should not require dislocation of any Spokane area residents.

Combination Concept. Construction of storage basin 8B in Peaceful Valley might require some relocation of residents, but the basin would be designed to accommodate the 1-year frequency storm rather than the 25-year storm as planned for Alternative 1. Therefore, the basin would be much smaller and fewer residences would be affected.

No-Action. No population dislocation would result with this alternative.

Mitigation Measures. Relocation assistance should be provided by the city to any displaced residents who might experience difficulty or hardships as the result of relocation. Assistance could include aid in securing replacement housing and aid in the physical movement of belongings from existing residences. The federal Uniform Relocation Act requires this assistance when federally-funded projects force the relocation.

Circulation Network

Alternative 1 - Storage Basins and Relief Sewers. Storage basin construction would temporarily interfere with traffic flow on a number of Spokane's major streets. Excavation at basin 14B would disrupt traffic on Northwest Boulevard at Garland Avenue and construction of basin 6B could affect traffic on Washington Street north of the river. Both of these streets are listed as major arterials in the city's Arterial Street Plan (Spokane City Traffic Engineering Department, 1966). Relief sewers would be placed in portions of Wellesley, Division, Nevada, Crestline, A, Grand and 2nd Streets; these streets are also major city arterials. The construction obstructions would be short-term, but could create heavy traffic congestion and public safety hazards. Numerous secondary arterials and less heavily traveled surface streets would also be affected by Alternative 1 construction activity.

Alternative 2 - Satellite Treatment and Relief Sewers. This alternative would create traffic problems in the same locations as described for Alternative 1, but the duration of the impact would be less as construction time for satellite plants is less than for storage basins.

Alternative 3 - Separate Storm Sewers. Separate storm sewer construction would affect up to 220 miles of city streets. Most of the city's major arterials would be influenced by construction along some part of its right-of-way or from crossing construction activity. No attempt will be made to list all of the streets affected, but worthy of note is construction on major downtown streets, including Main, Riverside, Sprague, Spokane Falls Boulevard, Monroe and 1st Avenue. Construction would be phased to affect only a few blocks on any given street at one time, but major traffic tie-ups in downtown could be expected. Close coordination between construction contractor and the city traffic engineering department would be essential.

Klicker Suboption. The Klicker storage suboption would result in circulation problems similar to those described for Alternative 1.

Latenser Plan. Traffic congestion related to relief sewer construction would be the same as described for Alternative 1. Most downtown storage basin construction would not occur. The major traffic tie-ups would result from separate storm sewer construction in small sections of eastern Spokane and from pipeline construction across Fort Wright Bridge. Meenach Drive across Fort Wright Bridge is listed as a secondary arterial on the city's arterial street plan (Spokane City Traffic Engineering Department, 1966). It is not known whether construction of the export system would create traffic problems, as specific facility locations have not been identified for this portion of the Latenser Plan.

Combination Concept. Traffic disruptions associated with the combination alternative would be a combination of those described for Alternatives 1 and 3. Storage basin construction at sites 14B and 6B would disrupt traffic on Northwest Boulevard and Washington Avenue, respectively. Construction of separate sewers in Mission Avenue and in the vicinity of the county courthouse could create major traffic tie-ups in those areas. The central business district and major shopping centers would not be affected under this project.

Mitigation Measures. Mitigation of circulation system impacts would be primarily the responsibility of the construction contractor. Relocation of construction to avoid major arterials could reduce circulation impacts, but the flexibility of specific pipeline routes has not been analyzed for this report. Construction timing with regard to peak traffic periods and provision of alternate traffic routes will be major factors in limiting the severity of impacts. Public safety precautions such as signing, use of flagmen and timely closure of excavations should be specified in the construction contract.

Employment and Economic Impacts of Construction

Employment

All of the alternatives except no-action would increase employment in the contract construction industry and in those businesses supplying materials for the project. (Separate discussion follows for each alternative.) The U. S. Bureau of Labor Statistics estimates that for every construction job, another half job is created in industries supplying building materials and transportation used in construction (multiplier effect). Since 1974, the construction industry in Spokane County has experienced steady growth, largely due to residential construction. Commercial and industrial construction has shown a lack of growth since 1976, and a decline in the first quarter of 1978 over that in 1977 (Spokane Area Development Council, 1978). Contract construction accounted for 4.7 percent of total Spokane County employment in 1977, which does not consider the important multiplier effect. In 1977, unemployment in the construction industry in Spokane County ranged from a low of 4.5 percent during the peak construction period to a high of 27 percent during the off-season (Gifford, pers. comm.).

Contract construction (exclusive of the alternatives under consideration) is expected to peak in 1978 and then level off in 1979 due to an anticipated decline in residential and commercial construction (Spokane Regional Planning Conference, 1976). The major employment provided by each of the alternatives would be in the heavy construction category, which includes street, sewer and heavy building construction. Labor statistics for the construction industry are shown in Table 4-3. A summary comparison of employment impacts for each of the alternatives is given in Table 4-4 at the conclusion of this section.

Business Activity

All of the structural alternatives would require purchase of large volumes of construction materials, which would benefit local business and industries supplying this demand. A separate discussion follows for each alternative, and a summary comparison of sales generated is given in Table . Disruptions caused by construction adjacent to some commercial areas would have a negative impact on sales. (See Land Use and Development for description of commercial and industrial areas impacted.)

Table 4-3

CONSTRUCTION INDUSTRY EMPLOYMENT SPOKANE COUNTY

Construction Category	Average Monthly Employment 1976	Average Monthly Employment 1977	Percent Change	Total Annual Payroll[1]	Average Weekly Earnings[2]	Average Weekly Hours[2]	Average Hourly Earnings[2]
General Building Contractors	1,893	1,700	-10.0	$26,363,000	310.96	36.8	8.45
Heavy Construction Contractors	861	900	+ 4.0	22,237,000	307.30	39.6	7.76
Special Trade Contractors	3,091	3,300	+ 7.0	46,817,000	321.12	36.0	8.92
Total	5,845	5,900		$95,417,000			

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[1] Washington Employment Security Department, 4th Quarter, 1976; 1, 2, and 3 Quarter, 1977.

[2] U. S. Bureau of Labor Statistics, U. S. average as of May 1, 1978 (does not include fringe benefits or reflect overhead costs).

Alternative 1 - Storage Basins and Relief Sewers. Very limited information is available as to the manpower and building supply requirements of this alternative. Based on similar public works projects it is estimated that 30 percent of construction costs, excluding land, design and engineering, and supervision and administration would be allocated to labor. Based on a total construction cost of $101,720,000 this would result in a total labor allocation of $30,516,000 during the estimated 2 to 3 years required for construction. Contracts in excess of $5 million would generally require large contractors from outside the area, such as Portland and Seattle (Gellner, pers. comm.). To the extent local labor is available, they are generally used by outside contractors. Based on average hours worked, an average 10-month construction season, and an average hourly pay of $12.00 per hour or $14,880 annually (includes fringe benefits), this alternative would require employment of from 683 to 1,025 persons annually, depending on the length of time required for construction. This would constitute from 76 to 114 percent of all heavy construction workers employed on a monthly average in Spokane County in 1977 (see Table 4-3). This would virtually eliminate unemployment in this sector of the construction industry and would necessitate a temporary influx of workers from outside labor markets. Although the beneficial impacts for workers would be substantial, such labor requirements would put unusual demands on the labor market and may adversely affect the labor supply for other construction projects in the city. Based on the multiplier effect, this alternative would generate additional employment of 342 to 512 persons in support industries during the construction phase. Building materials are expected to constitute one-third of total costs, resulting in sales of an estimated $33,907,000 in construction materials, which would have a substantial beneficial impact on the building supply sector. The above mentioned employment and payroll estimates are summarized for each alternative in Table 4-4 at the end of this section.

Adverse impacts on commercial activity would be primarily due to relief sewer construction and would include those factors discussed in Alternative 3. A reduction in business activity and revenue is expected due to construction in the strip commercial area on Division Street.

Division Street now experiences frequently heavy traffic congestion in the commercial zone and the construction work would compound this problem and reduce on-street parking. As Division Street businesses are almost exclusively oriented to drive-in traffic, the impact would be significant. Relief sewer construction would have generally the same impact on Shadle Center, Manito Center and Eastown as described in

Alternative 3. Storage basin construction could decrease revenue at the Downriver Golf Course concession-operated facilities. Overall, revenue losses would be less with this alternative than Alternative 3, due to lack of construction in the downtown area and the fewer number of community and local business areas affected.

Alternative 2 - Satellite Treatment and Relief Sewers. Very limited information is available as to manpower and building supply requirements for this alternative. Using the ratio of 30 percent of costs, to determine labor allocations, this alternative would result in a total payroll of $28,745,000 over the 2- to 3-year construction period. On the basis of those factors described in Alternative 1, annual employment would range from 644 to 966 persons annually, depending on the length of time required for construction. Workers required would constitute from 72 to 107 percent of all heavy construction workers employed in the county in 1977. Based on the multiplier effect, the alternative would generate additional employment of 322 to 483 persons in support industries during the construction phase. Total employment generated would be slightly less than with Alternative 1, and would have major beneficial impacts on the construction industry. Influx of workers from outside labor markets could be anticipated due to the large labor requirements. Assuming that one-third of the total cost is allocated for building materials, this alternative would result in sales of about $31,620,000 in construction materials, which would substantially benefit the construction industry. Adverse impacts on sales due to construction adjacent to commercial developments would be generally of the same type as described in Alternative 1. Loss of revenue at Downriver Golf Course may be slightly less due to the shorter construction period and smaller area disturbed.

Alternative 3 - Separate Storm Sewers. Using the ratio of 30 percent of costs to determine labor allocation, this alternative would generate $19,215,000 in payroll over the 8- to 10-year construction period. On the basis of those factors described in Alternative 1, annual employment would range from 129 to 161 persons annually, depending on the time required for project completion. Workers required would constitute from 15 to 19 percent of the heavy construction workers in the county. Although this represents a substantial percentage, the influx of workers from outside labor markets would be minor with this alternative. Based on the multiplier effect, this alternative would generate additional employment of 65 to 81 persons in support industries during the construction phase. Assuming that one-third of the project cost is allocated for building materials, this alternative would result in sales of about $21,000,000 in construction materials.

Short-term adverse economic impacts could result where extensive construction occurs adjacent to commercial development. Impacts would include loss in sales volume due to obstructed access to stores and parking areas, loss of on-street parking, traffic congestion, and nuisance factors such as excess noise and dust. Retail establishments would be most affected, particularly highway or strip commercial development where traffic problems and street parking limitations would be most pronounced, and in the downtown business area due to the extensive construction planned. Adverse impacts would occur only during the construction period, which may last anywhere from 2 weeks to more than a month. Except in the most marginal business areas, this would not be sufficient to result in significant long-term economic impacts. The most significantly impacted strip commercial area would be Garland Street. Businesses appear to be primarily small, older, owner-operated retail and service establishments, with heavy reliance on drive-in traffic. Garland is narrow and is the major source of parking for customers. Street construction would, therefore, have a greater than usual adverse impact on business sales.

Due to inherent complications of construction in the intensively used and developed downtown area, construction would occur over a longer period of time. A minimum of 3 to 5 months would be required to complete construction. The proliferation of above- and below-ground utilities in the area could slow construction considerably. The core represents the largest structures and greatest density of employees of any area within the region. Retailing, office and hotel uses predominate. The core also contains the highest volume of pedestrian and vehicular traffic of any area within metropolitan Spokane. To assist in evaluation of potential impacts and mitigation measures, property managers and representatives of large retailing concerns in the downtown area were consulted, and the following is based on information received from them. The estimated weekly volume of shoppers in downtown Spokane is 250,000 persons. Of these an estimated 75 percent arrive by private transportation, 21 percent by public transit, and 4 percent walk. Estimates of peak shopping hours ranged from 11:00 a.m. to 3:00 p.m. and 11:00 a.m. to 4:30 p.m. Most respondents believed that construction would have a significant adverse impact. Reasons cited were upsets in flow of traffic and parking, and confusion for potential customers. Types of impacts anticipated included loss of sales revenue and loss of sales tax revenue to the city. Most seriously impacted businesses listed were small and large retail establishments and fee parking facilities. Estimates of loss of sales ranged from a low to 5 to 10 percent to a high of 33 percent. Due to the regional drawing power of the downtown area and the plans to minimize adverse impacts by methods such as maintaining partial access on all downtown streets, a middle range of 10 to 15 percent loss of sales during construction would appear reasonable. Although this would represent a significant loss in sales revenue, it would generally not be considered sufficient to result in business failure or long-term economic loss.

The community shopping centers at Shadle Park, Manito, and Eastown may also experience loss of revenue due to construction planned adjacent to the centers. Shadle Park is a major shopping center in the northwest sector, accommodating 35 retail and service outlets.

Manito Center accommodates 11 retail and service establishments, and Eastown currently accommodates 10 retail and service outlets. Revenue losses of from 10 to 15 percent can be expected during the construction phase. A large number of small local business areas may suffer some loss of revenue due to construction activities. However, typically such establishments serve the daily needs of local residents within a 1/2 mile radius and would not be as affected by parking and traffic congestion problems. The concession-operated pro shop and restaurant at Downriver Golf Course may also lose revenue during construction adjacent to these facilities. Revenue losses would be greatest should construction occur during peak summer use at the course (Korff, pers. comm.). Although construction would be required in many wholesale and industrial zones, the primary impact would be temporary delays and inconvenience in the transport and delivery of merchandise and supplies rather than actual significant losses of revenue.

Klicker Storage Suboption. Using the ratio of 30 percent of costs to determine labor allocations, this alternative could generate $18,161,460 in total payroll over the 2 to 3 years required for construction. On the basis of those factors described in Alternative 1, annual employment would range from 407 to 610 persons, depending on the time required for construction. Workers required would constitute from 45 to 68 percent of all heavy construction workers employed in the county. Influx of workers from outside labor markets could be anticipated due to the large labor requirements. Based on the multiplier effect, the alternative would generate additional employment of from 204 to 305 persons. Assuming that one-third of total cost is allocated for building materials, the alternative would result in sales of $18,161,400 in construction materials. Adverse impacts on sales due to construction adjacent to commercial development would be generally the same as described in Alternative 1.

Latenser Export Plan. Using the ratio of 30 percent of cost to determine labor costs, this alternative could generate $31,693,500 in total payroll over the 2 to 3 years required for construction. Annual employment would range from 710 to 1,065 persons, depending on the time required for construction. Workers required would constitute from 79 to 118 percent of all heavy construction workers employed in the county. A large influx of workers from outside labor markets employed in the county. A large influx of workers from outside labor markets would be required. Based on the multiplier effect, the alternative would generate additional employment of from 355 to 533 persons. Assuming that one-third of total cost is allocated for construction material, the alternative would result insales of $34,862,850 in building materials. Adverse impacts would be limited primarily to relief sewer construction and would be the same as Alternative 1.

Combination Concept. Using the ratio of 30 percent of costs to determine labor allocations, this alternative could generate $15,925,200 in total payroll over the 3 to 5 years required for construction. Annual employment would range from 214 to 356 persons, depending on the time required for construction. Workers required would constitute from 24 to 40 percent of all heavy construction workers employed in the county. Due to the multiplier effect, the alternative would generate additional employment of from 107 to 178 persons. Assuming that one-third of total cost is allocated for construction material, the alternative would result in sales of $17,517,720 in building materials. Some adverse impacts could be expected due to construction of storage basins and relief sewers and would be similar to those described in Alternative 1. Separate storm sewer construction would occur in some industrial areas and on the northern fringe of the downtown area. However, the core downtown area would not require separate storm sewer construction and would be only affected by relief sewer construction. Overall, adverse impacts on commercial uses would be significantly less than with Alternative 3, but somewhat greater than for the other alternatives.

No-Action. As this alternative would require no construction, there would be no impacts on employment or economic conditions.

Mitigation Measures. A number of measures could be implemented to reduce the loss of sales revenue associated with relief sewer and storm sewer construction. In the more significantly impacted commercial areas, work should be limited to one block at a time, and at least partial access maintained at all times. Construction should be avoided at major shopping areas during the peak season between October 1 and January 1. Representatives of the downtown business area recommend the following measures to minimize impacts: 1) limit work to one block segments; 2) perform street work in evening when possible or before and after peak shopping hours; 3) plan construction between January 1 and July with no construction between the holiday season from October 1 to January 1; 4) keep one or two lanes open on streets under construction, and remove parking meters if necessary to accomplish this; and 5) move construction equipment on weekends.

Table 4-4

SUMMARY COMPARISON OF EMPLOYMENT AND CONSTRUCTION SALES IMPACTS

Alternative	Total Payroll-Generated Dollars	Estimated Annual Employment	Duration of Employment	% of Total Construction Employment (Countywide)	Building Material Sales Dollars
#1 - Storage Basins and Relief Sewers	$30,516,000	683 to 1,025	2-3 yrs.	76.0 to 114.0	$33,907,000
#2 - Satellite Treatment and Relief Sewers	28,745,000	644 to 966	2-3 yrs.	72.0 to 107.0	31,620,000
#3 - Separate Storm Sewers	19,215,000	129 to 161	8-10 yrs.	15.0 to 19.0	21,000,000
#4 - Klicker Storage Sub-option	18,161,460	407 to 610	2-3 yrs.	45.0 to 68.0	18,161,400
#5 - Latenser Export Plan	31,693,500	710 to 1,065	2-3 yrs.	79.0 to 118.0	34,862,850
#6 - Combination Concept	15,925,200	214 to 356	3-5 yrs.	24.0 to 40.0	17,517,720

Influence of Alternatives on Spokane River Quality

History of Water Quality Management and Planning on the Spokane River

The Spokane River's value as a water resource has been a major factor in the settlement and growth of the Spokane area for over 100 years, but it has only been in the last 25 to 30 years that there have been attempts to manage and protect that resource for its diversity of uses. The U. S. Geological Survey has measured flows in the river at Long Lake Dam since it was constructed for power production in 1913. Since that time other stream gauging stations have been constructed to monitor both flows and water quality in the river. In the meantime, the river has been further dammed and developed as a source of power and irrigation water supply and has been used as a receptacle for the area's domestic and industrial wastewater. It was not until the early and mid 1950's that studies were undertaken to analyze the water quality situation and develop means of improving river quality and use. Reports by the U. S. Public Health Service (1952), the Washington State Pollution Control Commission (1954; now part of DOE), and others began to identify the severity of the pollution problem and prompted construction of the first Spokane wastewater treatment plant in 1958. Since that time, the City and County of Spokane and the Washington Department of Ecology, among others, have continued to study the river and plan for its improved quality and expanded use.

The impetus for recent pollution abatement actions is the Federal Water Pollution Control Act (FWPCA) of 1965 and subsequent amendments of 1972. This act gives both direction and purpose to federal, state and local entities involved in water resources management. It requires that both point and nonpoint sources of stream pollution be identified and eliminated by 1985. In response to these directives, the state has participated in a number of activities designed to improve water quality management.

In 1972, the Office of Water Resources and Technology (U. S. Department of Interior) and DOE sponsored a detailed water quality analysis of the lower Spokane River system conducted by Dr. Ray Soltero of Eastern Washington University. In addition, the Department of Ecology has prepared priority lists and administered federal-state grants for upgrading of municipal wastewater treatment systems that discharge into Spokane River basin waterways. The Department of Ecology has also prepared a basin-wide water quality management plan (Washington Department of Ecology, 1976a) to act as a framework for developing and judging local wastewater facilities planning efforts.

Local government efforts since 1972 have concentrated on improving wastewater treatment systems. The City of Spokane prepared an action plan in 1972 (Esvelt and Saxton Bovay Engineers, Inc., 1972) that has led to design and construction of an advanced wastewater treatment plant and implementation of this CSO abatement planning effort. Spokane County has similarly prepared facilities plans for the north Spokane suburban area and the Newman Lake area. In addition, the Liberty Lake Sewer District is in the process of preparing a facilities plan for its portion of the Spokane Valley urban area.

The U. S. Army Corps of Engineers has carried out the most comprehensive water resources inventory and planning effort in the area to date. Its 1976 water resources study for the entire metropolitan Spokane area (U. S. Department of Army, Corps of Engineers, 1976) provided data and planning guidelines for controlling both point and nonpoint sources of water pollution. This data has subsequently been used by local government entities in their water resources planning (e.g., City of Spokane, Spokane County).

In response to Section 208 of the FWPCA, the U. S. Environmental Protection Agency is sponsoring two water quality management plans in the area aimed at remedying nonpoint source pollution of surface and groundwater. The Water Quality Management Plan, Rathdrum Aquifer (Panhandle Area Council, 1978) deals with sources of surface and groundwater pollution in the Idaho Panhandle area. This is important to the Spokane area because both the Spokane River and the Spokane Valley aquifer originate in this area. The Spokane County Engineers are conducting a similar 208 planning study for that portion of Spokane County underlain by the aquifer. Federal, state and local water resources planning and management will be guided in the following years by recommendations presented in these 208 plans, the Department of Ecology Water Quality Management Plan for the Spokane basin, and local facilities plans prepared under the auspices of EPA and the Department of Ecology.

Parameters and Methods of Analysis

The most recent effort in the Spokane area to eliminate identified point sources of pollution as required by FWPCA Amendments of 1972 is the plan proposed to reduce CSOs from the City of Spokane. Alternatives considered include: storage of overflows for later treatment (Alternative 1 and Klicker Plan); storage with export (Latenser Plan); satellite treatment plants (Alternative 2); complete separation of storm and sanitary sewer system (Alternative 3); and a combination of storage and sewage separation (Combination Concept).

Each alternative is evaluated here according to how much it would reduce the present waste load exerted by the city on the Spokane River, and how much it would reduce the nitrogen and phosphorus load entering Long Lake annually and during the principal growing season for aquatic vegetation (May 1 through September 30). The estimated reductions in city loading are expressed as the average percentage of the total load, which includes the sewage treatment plant tertiary effluent, combined sewer overflow and stormwater plant effluent (Table 4-5). The mean percent of total nitrogen and total phosphorus load entering Long Lake was then estimated (Table 4-6) from data collected by R. Soltero during 1978 (Soltero, pers. comm.).

Parameters considered in evaluating the alternatives were:

Biochemical Oxygen Demand (BOD5). An index to the amount of dissolved oxygen required to meet demands of aerobic bacteria in the decompositon of organic matter (generally a 5-day arithmetic average).

Suspended Solids (SS). A measure of the particulate matter within the water which could be removed by centrifugation or filtration under specified test conditions.

Total Nitrogen (TN). All organic and inorganic forms of nitrogen as N.

Total Phosphorus (TP). All organic and inorganic forms of phosphorus as P.

The bacteria and viral character of Spokane River water quality is discussed in the following section of Chapter 4 titled Ability of Alternatives to Alleviate Public Health and Aesthetic Concerns.

The load reductions of BOD_5, SS, TN and TP shown in Tables 4-5, 4-6, and 4-7 are the products of average annual flows presented in Table B-11 (Appendix B) and average water quality characteristics shown in Table B-10 (Appendix B). The calculated percent reductions under each alternative are, therefore, best estimated within ranges of possible values.

Effects of Proposed Alternatives on Nutrient Loading

All of the alternatives except Alternative 3 and the Latenser Plan would remove approximately equal amounts of BOD_5, SS, TN and TP (Table 4-5). Only the Latenser Plan includes export of wastewater after it has been stored and treated and therefore greatly alters loading to the river. In all other alternatives, the extra wastewater introduced into the sewage treatment system during storms must eventually add to the normal dry weather discharges of treated effluent from the plant. The 99 plus percent removal projected under

Table 4-5

PROJECTED PERCENT OF PRESENT CITY WASTE LOAD REMOVED*

Alternative	BOD_5	SS	TN	TP
Alternative 1				
1 yr. storage	15	17	<1	<1
25 yr. storage	16	17	<1	<1
Alternative 2	12	16	<1	<1
Alternative 3	16	-163**	22	21
Klicker Plan	16	17	<1	<1
Latenser Plan	>99	>99	>99	>99
Combination Concept	17	-15**	3	5

*Sewage treatment plant tertiary effluent discharge plus stormwater plant discharge plus combined sewer overflows to the Spokane River removed annually by each alternative.

**Added to present city load.

NOTE:

The product of flows from appropriate discharge points (Table B-11, Appendix B) and the expected water quality of each of these discharge sources (Table B-10, Appendix B) was converted to projected load in tons per year for each alternative. Each load was subtracted from then divided by the total annual city waste load (Table B-12) to approximate the annual percent removal by each alternative.

the Latenser Plan demonstrates how little a single overflow each year contributes to the loading compared to the load which the treatment plant adds to the river. The Latenser Plan removes the plant discharge (99 plus percent removal) and leaves a single overflow event each year (<1 percent of present loading).

Biochemical Oxygen Demand (BOD$_5$). Organic substances and ammonia discharged into the river from Spokane's sewage treatment plant and combined sewer overflow points are degraded by bacteria. This decomposition consumes oxygen from surrounding water. Sampling for dissolved oxygen levels in the Spokane River below the city has revealed high concentrations, suggesting that the river is able to assimilate the waste-related BOD load through turbulent mixing and photosynthesis.

The Latenser Plan would remove essentially all of the city's BOD$_5$ load on the river (Table 4-5). The other four alternatives would reduce the load about 12 to 21 percent. How much the city load represents compared to the total BOD$_5$ load entering Long Lake is unquantified. A study by Cunningham and Pine (1969) concluded that the Spokane River probably does not contribute directly to the anaerobic condition of Long Lake. Rather, nutrients from the river stimulate growth of phytoplankton which later decay and consume oxygen.

Suspended Solids. The removal of suspended solids would not only increase water clarity in the Spokane River, but also reduce the influx of bacteria, viruses, heavy metals, nutrients and other agents adsorbed onto those particles.

The most effective alternative for removing suspended solids would be the Latenser Plan (Table 4-5). Alternatives 1, 2 and the Klicker Plan would remove 16 or 17 percent of the load, representing a minor improvement. Alternative 3 and the Combination Concept would increase the amount of suspended solids contributed by the City of Spokane. The significant increase projected under Alternative 3 would be from mineral solids, such as dust and grit from streets, entering the river in stormwater runoff . A large amount of these materials now go to the sewage treatment plant. The organic solids from sewage wastes would be eliminated from this runoff. Implementing Best Management Practices, e.g., sweeping streets and paving dirt roads, should reduce this projected increase.

Nitrogen and Phosphorus. Although no standards for nitrogen or phosphorus have been established in the Washington State Water Quality Standards (Washington State Department of

Ecology, 1977), the Washington State Department of Ecology believes phosphorus is important enough to require its year-round removal from Spokane's sewage treatment plant effluent (NPDES Permit No. WA-02447-3; Washington Department of Ecology, 1977a). Numerous studies have confirmed that phosphorus supply is the primary determinant of algal community biomass and production in most temperate zone lakes (Kalff and Knoechel, 1978).

Approximately 1,200 tons of total nitrogen (TN) enter Washington from Idaho (based on average annual flows from USGS and water quality data from the U. S, Army Corps of Engineers [1976]). This nitrogen loading represents about 60 percent of the approximate 2,030 tons entering Long Lake during 1978. The City of Spokane contributes roughly 730 tons of total nitrogen (36 percent) to this Long Lake load annually.

Idaho contributes about 70 tons of total phosphorus annually to the Spokane River, which is approximately 31 percent of the 225 tons that entered Long Lake during 1978. Roughly 80 tons (36 percent) of the total phosphorus are contributed by Spokane annually. These percentages are only estimates and would surely vary from year to year, but they do put relative contributions in perspective.

The percent removals for each alternative shown in Table 4-5 are portions of the 730 tons per year of total nitrogen or 80 tons per year of total phosphorus discharged by the city through the treatment plant outfall and combined sewer overflows. These values were calculated using water quality data which reflect improvements realized from the treatment plant's new phosphorus removal facilities. Also, the tons per year removed by each alternative were assumed to be the same for both 1977 and 1978 analyses; the percent removed from the annual TN and TP load entering Long Lake increased in 1978 because the actual total loading to the lake decreased.

Latenser's Plan for exporting effluent to Crab Creek would remove essentially all of the city's TN and TP from the Spokane River (Table 4-5). Thus, 36 percent of the total annual nitrogen and phosphorus load to Long Lake could be removed (Table 4-6). This removal would also reduce TN loading by 44 percent and TP loading by 64 percent during the growing season (Table 4-7). The nutrient concentrations resulting in Long Lake from these reductions cannot be predicted without considering other factors such as water retention time within the reservoir. Nevertheless, the water quality in Long Lake would be expected to improve significantly. During 1978 the lake's algal standing crop decreased, water clarity improved, and less anoxia was noted (Soltero, pers. comm). The most likely cause for these improvements was the

Table 4-6

POTENTIAL PERCENT OF ANNUAL TOTAL NITROGEN AND TOTAL PHOSPHORUS LOAD TO LONG LAKE REMOVED BY EACH ALTERNATIVE

	Removed from Estimated 1977 Total Load to the Lake		Removed from Estimated 1978 Total Load to the Lake	
Alternative	TN	TP	TN	TP
Alternative 1				
1 yr. Storage	Add <1	<1	Add <1	<1
25 yr. Storage	Add <1	<1	Add <1	<1
Alternative 2	<1	<1	<1	<1
Alternative 3	5	5	8	7
Klicker Plan	Add <1	<1	Add <1	<1
Latenser Plan	22	23	36	36
Combination Concept	<1	1	1	2

SOURCES: Soltero, et al., 1977; Soltero, pers. comm.

NOTE:

The tons per year of waste load (TN & TP) removed by each alternative, which was determined to construct Table B-12, was divided by the TN and TP load entering Long Lake annually to estimate the percent removals given above. The TN and TP values for Long Lake were taken from a report by Soltero, et al., 1977 and from unpublished data collected during 1978 by R. Soltero (Soltero, pers. comm.).

Table 4-7

ESTIMATED PERCENT OF TOTAL NITROGEN AND TOTAL PHOSPHORUS REMOVED FROM LONG LAKE BY EACH ALTERNATIVE DURING THE 1978 GROWING SEASON (MAY 1 THROUGH SEPTEMBER 30)

Alternatives	TN	TP
Alternative 1		
1 yr. storage	Adds <1	<1
25 yr. storage	Adds <1	<1
Alternative 2	<1	<1
Alternative 3	10	13
Klicker Plan	Adds <1	<1
Latenser Plan	44	64
Combination Concept	1	3

NOTE:

Five twelfths of the tons per year potentially removed from the present city TN and TP load by each alternative was divided by the TN and TP loading to Long Lake calculated from unpublished data (Soltero, pers. comm.) to provide the result above.

operation of the new phosphorus removal facilities at Spokane's wastewater treatment plant. The Latenser Plan would remove a comparable amount of TP as well as TN.

Implementing Alternative 3 would remove about 8 percent of the annual TN load and 7 percent of the annual TP load (Table 4-6). During the growing season, reductions would be greater, i.e., 10 percent TN and 13 percent TP (Table 4-7). Whether these nutrient reductions would significantly or even noticeably improve surface water quality below the city is difficult to judge. Expected improvements would be similar to those described for the Latenser Plan, but proportionately smaller.

No significant improvements in receiving-water quality would be expected if any of the remaining alternatives were implemented. None would reduce the present loading more than a few percent (Tables 4-6 and 4-7).

Ability of Alternatives to Alleviate Public Health and Aesthetic Concerns

Surface Water Contamination

Water is recognized as a conveyor of human and animal disease agents. The biological agents can be conveniently cataloged as bacterial, viral and parasitical. In the United States the bacteria of most concern are members of the genus Shigella (bacillary dysentery - Shigellosis) the genus Salmonella (typhoid and salmonellosis) and entero-toxogenic Escherichia coli. More than 100 virus types associated with human fecal material can be categorized into viral groups including polio, ECHO, coxsackie, REO and infectious hepatitis. The most serious diseases are associated with polio virus and infectious hepatitis virus. In the United States poliomyelitis is not now a serious threat because of active immunization campaigns. The other viruses (ECHO, etc.) generally cause less severe diseases except among those who are very susceptible because of age or physical condition. Water-borne parasitical diseases of importance in the United States are giardiasis and amoebic dysentery.

Chemical disease agents include metals (such as cadmium, mercury, lead and arsenic), nitrates and asbestos, and particularly pesticides and herbicides. Recently there has been a growing concern as to the toxigenic properties of a myriad of low molecular weight organic compounds, such as the trihalomethanes, which may occur in water and wastewater. The concern centers about the carcinogenic/mutagenic nature of these compounds and the effects of long-term exposure to low concentrations consumed with drinking water and food.

The surface water contamination of concern in this study is that created by storm-caused CSOs. Although storms occur throughout the year in Spokane, the winter and spring months typically have the most storms and the largest monthly precipitation. A large percentage of the winter precipitation (November to March) falls as snow, however, while most spring and summer precipitation (April to October) is rain. Overflows from the city's combined sewer system appear to occur most frequently when spring rains coincide with snowmelt, or when heavy, short duration rainfalls occur in the summer.(see Figure 4-6). There are approximately 27 points along the Spokane River and one along Hangman Creek where overflows from the city system occur. The location and volume of overflows varies tremendously from storm to storm, depending primarily on the local pattern of rainfall. Estimates of the number of annual overflow events have ranged from 79 to 110 depending upon the minimum amount of rainfall considered sufficient to trigger an overflow. The actual number and volume of overflow to the river is not monitored by the city.

In attempting to evaluate the public health implications of various sewage disposal systems one must first be aware of the presence of the aforementioned pathogenic agents as well as others. Secondly, the dose or concentration of those agents present must be considered. In this instance the ability of various CSO control processes to reduce the dose must be estimated. Finally, the evaluator must consider the dose contact, i.e., how does the susceptible population come into contact with the agent and with what frequency.

In making an evaluation of the risk involved in any CSO control scheme there are two ends to a spectrum based upon intensity of "dose contact". The low risk would be associated with a situation in which no contact can be made between a susceptible host and the wastewater, regardless of degree of treatment. High risk would be associated with intimate contact (ingestion) with raw wastewater.

The Spokane County Health District has no documented evidence of any diseases being contracted by individuals using the Spokane River during combined sewer overflows (Pickett, pers. comm.). It was stressed, however, that this lack of documentation does not mean that no illnesses have occurred. Several doctors in the area have reportedly attributed infections to contact with wastewater. Where the contact occurred has not been specified.

Pathogenic Organisms. Contamination of water by pathogenic organisms is normally monitored by testing for the presence of fecal coliform bacteria. Even though the fecal coliform is only one of many known disease-carrying agents found in water, it is considered a good indicator of contamination by human wastes which are known to carry a variety of other potentially harmful pathogens. High levels of fecal coliforms in water indicate the potential for a significant health hazard to humans.

Combined sewer overflows carry varying concentrations of pathogenic organisms, depending upon the relative amounts of domestic wastewater and storm runoff that have combined to create the overflow. Data collected in a national survey by EPA (1977a) characterized fecal coliform levels in CSO as ranging from 201,000 to 1,140,000 MPN per 100 ml. Two samples taken from the T. J. Meenach overflow in November 1974 (after first flush) had fecal coliform levels of 460,000 and 2,400,000 MPN per 100 ml (Spokane City Department of Public Works, 1977, Text). More recent samples (August and November 1977) taken from the Meenach overflow by the Washington Department of Ecology (pers. comm.) recorded somewhat lower fecal coliform levels -- 107,800 and 120,000 MPN per 100 ml. It is obvious that no single number can be used to characterize fecal coliform levels in CSO. In order to understand the public health risks associated with CSOs, however, it helps to consider what a "typical" overflow situation might entail.

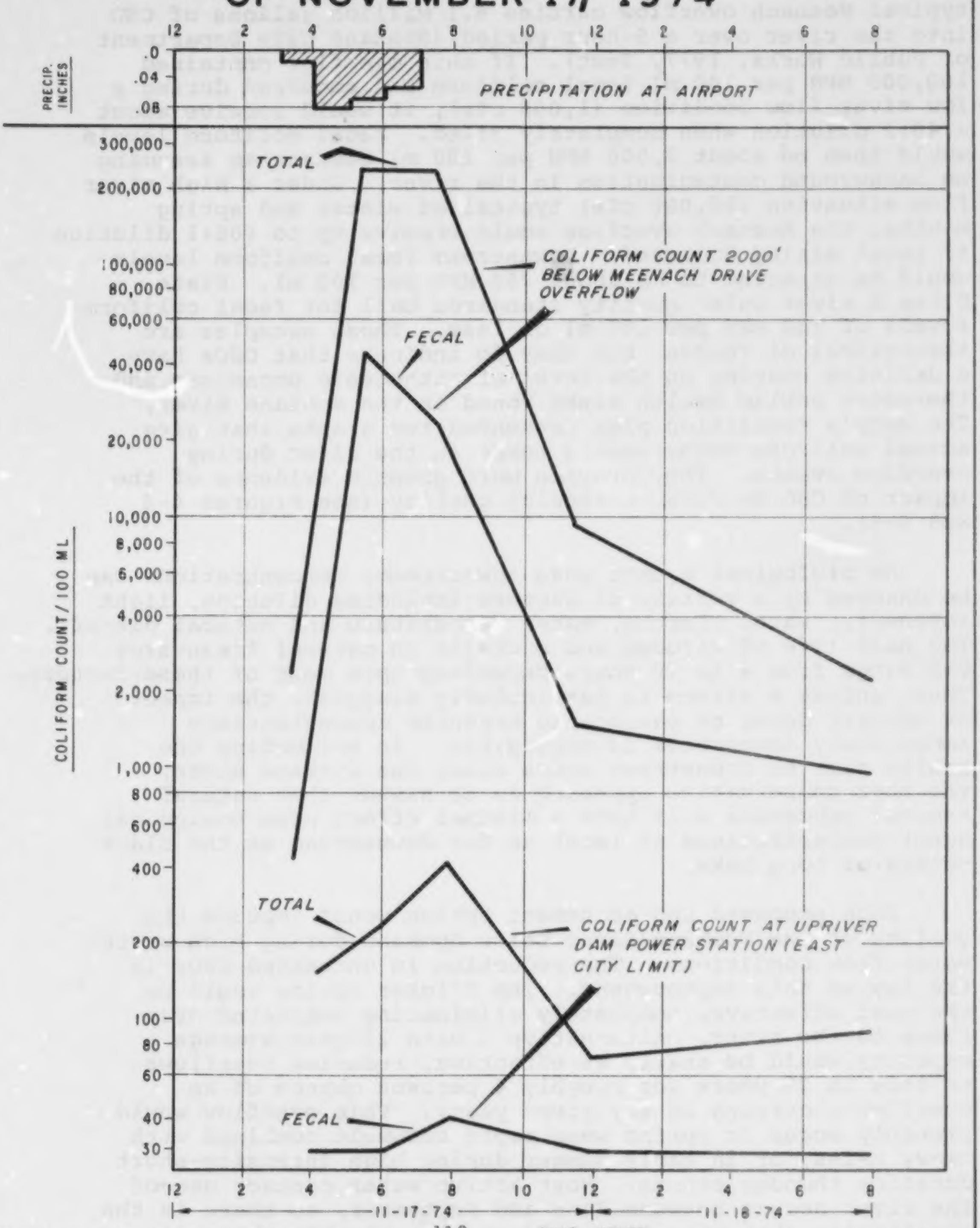
The Meenach overflow carries the largest annual discharge to the Spokane River. The city facilities plan indicated a typical Meenach overflow carries 6.1 million gallons of CSO into the river over a 9-hour period (Spokane City Department of Public Works, 1977, Text). If this overflow contained 100,000 MPN per 100 ml fecal coliform and occurred during a low river flow condition (1,000 cfs), it would receive about a 40:1 dilution when completely mixed. Fecal coliform levels would then be about 2,500 MPN per 100 ml downstream assuming no background contamination in the river. Under a high river flow situation (10,000 cfs) typical of winter and spring months, the Meenach overflow could receive up to 400:1 dilution if total mixing occurred. Downstream fecal coliform levels would be expected to be about 250 MPN per 100 ml. State Class A river water quality standards call for fecal coliform levels of 100 MPN per 100 ml or less. These examples are theoretical of course, but they do indicate that CSOs have a definite bearing on the level of pathogenic organisms and therefore public health risks found in the Spokane River. The city's facilities plan presented two graphs that give actual coliform measurements taken in the river during overflow events. They provide more graphic evidence of the impact of CSO on river bacterial quality (see Figures 4-4 and 4-5).

As biological agents move downstream, concentrations can be changed by a variety of factors including dilution, light intensity, water clarity, water temperature and natural die-off. The half life of viruses and bacteria in natural freshwater can range from 4 to 30 hours depending upon most of these factors. Thus, unless a stream is particularly sluggish, the impact of natural decay on pathogenic organism concentrations immediately downstream is negligible. In estimating the health risk to downstream users along the Spokane River, the most conservative approach is to assume that natural removal processes will have a minimal effect upon biological agent concentrations at least as far downstream as the slack waters of Long Lake.

Each proposed CSO abatement option would improve the quality of the Spokane River below Spokane during high wastewater flow conditions. The reduction in untreated CSOs is the key to this improvement. The Klicker option would be the most effective, completely eliminating untreated overflows to the river. Alternative 1 with 25-year storage capacity would be nearly as effective, reducing overflows to once in 25 years (or roughly 4 percent chance of an overflow occurring in any given year). This overflow would probably occur in spring when rapid snowmelt combined with heavy rains, or in early summer during high intensity-short duration thunder storms. Most active water contact use of the river occurs between June and September, so there is the possibility that this CSO would create a health threat to people in direct contact with the river between Spokane and Long Lake.

FIGURE 4-4

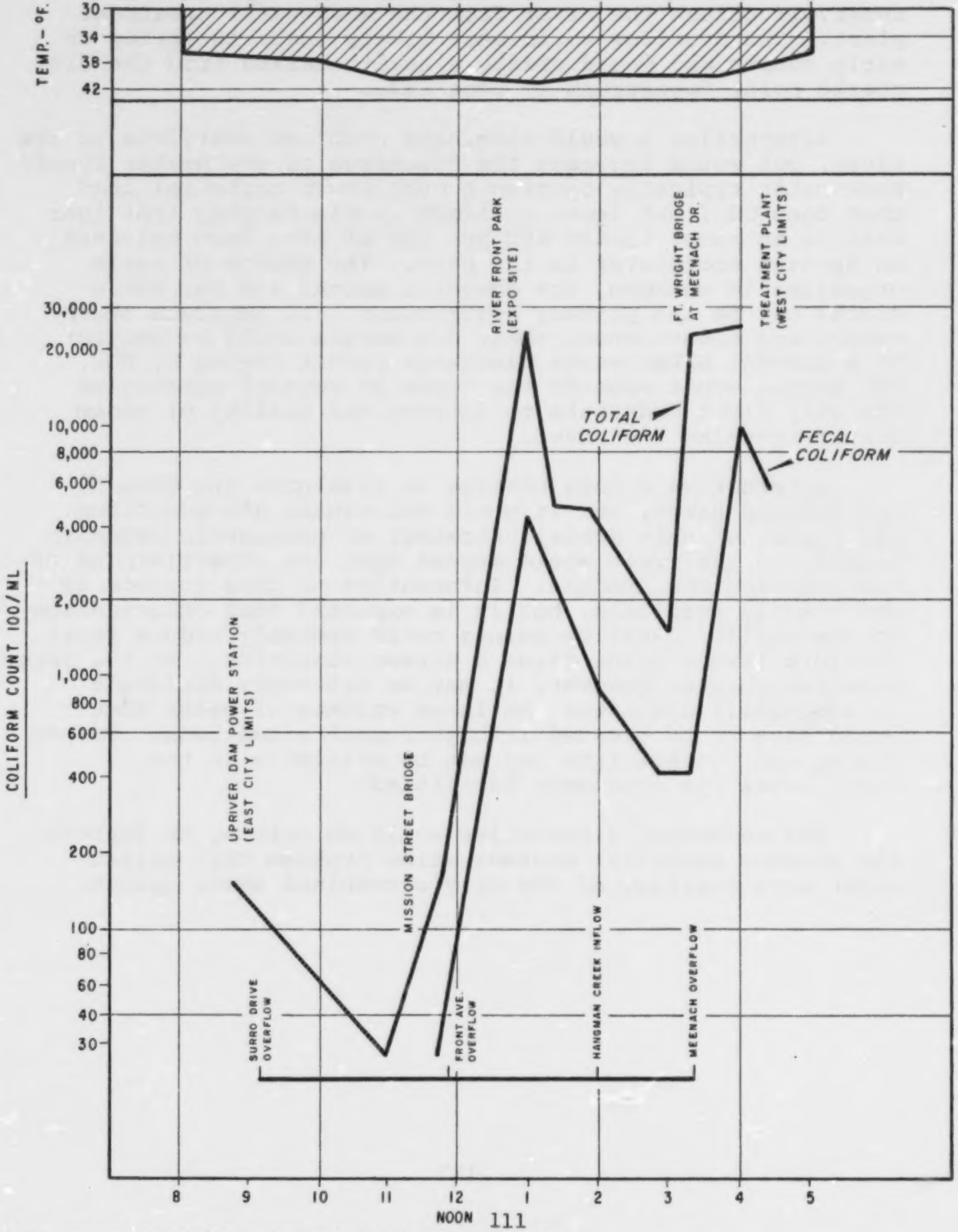
COLIFORM COUNTS TAKEN IN SPOKANE RIVER DURING RAINSTORM OF NOVEMBER 17, 1974



SOURCE: CITY OF SPOKANE DEPT. OF PUBLIC WORKS, 1977, TEXT

FIGURE 4-5

COLIFORM COUNTS TAKEN IN SPOKANE RIVER DURING PERIOD OF STEADY RUNOFF FROM SNOWMELT ON FEBRUARY 13, 1975



SOURCE: MODIFIED FROM CITY OF SPOKANE DEPT. OF PUBLIC WORKS, 1977, TEXT

Under the Latenser Plan and Alternative 1 with limited 1-year storage capacity, one overflow event would probably occur each year (100 percent chance of an overflow occurring in any given year). The Alternative 1 overflow could occur at any or all of the 14 storage basin locations. The single overflow from the Latenser Plan could occur at the Trent or Clark Street pump stations and/or at the large storage reservoir across the river from the wastewater treatment plant. The overflow would most likely occur in spring or early summer and would create a health hazard from the discharge point downstream to Long Lake.

Alternative 3 would eliminate combined overflows to the river, but would increase the discharge of stormwater runoff. Stormwater typically carries a much lower bacterial load than does CSO, but fecal coliform levels ranging from less than 30 to about 11,000 MPN per 100 ml have been measured in Spokane stormwater in the past. The source of these organisms is unknown, but domestic animal and not human wastes may be the primary contributor. If separate storm sewers are constructed, their discharges could be subject to a general NPDES waste discharge permit issued by DOE. The permit would specify the types of control strategies the city might undertake to improve the quality of storm runoff reaching the river.

Alternative 2 does nothing to eliminate the CSOs to the Spokane River, but it would chlorinate all overflows. The impact of this control strategy on pathogenic organism hazards in the river would depend upon the effectiveness of the chlorination process. Information on this subject is not readily available, but it is expected that chlorination at the smaller overflow points could probably reduce fecal coliform levels below Class A stream standards. At the larger overflow points, however, it may be extremely difficult to adequately disinfect the large volumes of water that would have to be treated in high runoff situations. Proper mixing and contact time may not be available in the small satellite treatment facilities.

The no-action alternative would do nothing to improve the present bacterial contamination problem that arises after each overflow of the city's combined sewer system.

Aesthetics

Trash and Floating Materials. The heaviest CSOs enter the Spokane River (and eventually Long Lake) during spring snowmelt or the intense, short-duration rainstorms of spring and summer. During these same seasons, the Spokane River and Long Lake receive the heaviest use by swimmers, boaters, fishermen, etc. Persons recreating at Long Lake have complained about "toilet paper", and other sewage-related refuse which collects occasionally in the backwaters and along the shores.

Klicker's proposal to end all overflows to the Spokane River would eliminate Spokane's contribution to the aesthetic problems created by large waste solids in Long Lake. Satellite plants (Alternative 2) would remove nearly all of these larger solids by screening and settling. Overflow reductions would confine the frequency of the problem to once each year (Alternative 1 and Latenser) or once every 25 years (Alternative 1 - Suboption) and greatly reduce the volume of overflows. Some trash and animal fecal matter could enter the river through storm sewers if Alternative 3 were constructed. Screening and Best Management Practices applied to urban clean-up would help mitigate this potential problem.

Water Clarity. Suspended solids from Spokane's CSOs detract from the clarity of Spokane River water, especially during low flows. Sediments from Hangman Creek and upstream areas mask the effect of CSOs during high flows. The Latenser Plan (storage and export) would eliminate nearly all suspended sediment loading contributed by the City of Spokane (Table 4-5). Alternatives 1 and 2 and the Klicker Plan would each reduce this loading about 16 to 17 percent. Under the Combination Concept more suspended solids would be expected to enter the river than now. Complete separation (Alternative 3) would allow sediment-laden stormwater to enter the river directly and substantially increase (163 percent) the city's loading of suspended sediments. Establishing prudent Best Management Practices for storm sewer and street cleaning should improve the quality of stormwater runoff and help mitigate the impacts introduced by sewer separation.

Chemical Health Hazards. Inorganic and organic chemicals can be introduced into surface waters by combined sewer overflows. Metallic compounds are typical inorganic agents thought to be harmful to man. Organic compounds such as pesticides, herbicides and trihalomethanes are also considered a health threat even in low concentrations.

The Latenser Plan would eliminate most waste-related chemical hazards coming from the City of Spokane by exporting all wastewater from the basin. The hazard would be relocated in Crab Creek. Alternatives 1 and 2, the Klicker Plan and the Combination Concept provide some level of treatment to most CSOs, but there is relatively little known about how effective the typical wastewater treatment processes are at removing the chemicals of concern. Alternative 3 would ensure treatment of the sanitary wastes now being discharged untreated as CSO, but all stormwater would pass directly to the river with no treatment. Those chemical contaminants (Table B-1) typically washed into the wastewater system by surface runoff will continue to flow into the river with no treatment.

Keeping potentially hazardous chemicals out of surface waters is best accomplished through source control. Manufacturers and users of these materials must be educated about their hazards and they must be encouraged to carefully handle and dispose of used chemicals and chemical containers. Pollutants that collect on streets and other paved areas should be cleaned up and disposed of in landfills or other appropriate disposal sites rather than simply be washed into drainage systems. Federally-sponsored 208 planning efforts are designed to confront these nonpoint sources of water pollution.

Algal Toxicity. Blooms of reportedly toxin-producing algae such as Anabaena flos-aquae and Microcystis originosa have occurred in Long Lake. If these algal blooms are limited by phosphorus and/or nitrogen loading, CSO abatement (which removes little of either nutrient) probably will not reduce this problem.

Groundwater Contamination

Groundwater exchange between subsurface aquifers and the Spokane River below Spokane results in a net flow into the river. There may be some transfer of water from the river to the aquifer during the dry season, but no incidents of contamination have been reported to local health or planning officials (Card, pers. comm.). Therefore, it appears that none of the CSO alternatives would significantly alter current conditions, but could reduce the potential for future groundwater contamination.

Sewer System Backups

During heavy rainstorms, many of the existing sewer trunk lines in Spokane are reportedly taxed beyond capacity. The combination of normal sanitary waste flows and stormwater runoff hydraulically overloads the smaller sewer lines, causing wastewater to backup and overflow at low points in the system. These low points are frequently manholes, basement drains or ground-level bathrooms of residential and commercial structures that are hooked to the trunk lines by sewer laterals. These overflows represent a threat to public health, are a nuisance, and a cause of property damage.

The history of sewer backups is not well documented in Spokane. They are only brought to the attention of the city when those persons affected either call the utilities department to seek aid in pumping out flooded basements or when claims for damages are filed with the city. No attempts have been made to keep detailed records and maps of backup frequencies and locations, but general information compiled by the Spokane City Department of Public Works and Utilities Department indicates that at least 1,400 backup event occur each year. (Fourteen hundred structural floodings, including some structures that are affected several times a year, [James, pers. comm.]). The number obviously varies from year to year, depending on the number and intensity of rainstorms that hit Spokane. A normal year might include 80 to 100 stormy days capable of causing backups at some locations in the city. Records maintained by the city and its insurance company indicate that each backup results in an average of $700 in property damage and/or cleanup costs (James, pers. comm.).

Due to the general nature of the information available on backups and the anticipated significance of fiscal and environmental impacts associated with backup correction, letters have been forwarded to the City of Spokane requesting a more thorough description of the problem. Location, extent and frequency of backups need to be more accurately determined, and the fiscal impact of the backups needs to be looked at in greater detail. This information has not been developed in time to present in the Draft EIS, but should be available for inclusion in the final report. More accurate descriptions of the problem are essential to determining the severity of the present public health threat and the fiscal reasonableness of the proposed control measures.

Backup locations vary with the intensity of the storm, but some small areas north of the river flood almost every time there is a storm. Residential areas near the intersections of Division and Mission, and Lincoln and Knox are two such areas. Less frequent but occasional backups occur in the Hollywood northwest area, in the northeast quadrant of town north of Wellesley, in scattered south-town locations around Manito Park, and southeast of the Sprague-Perry Street intersection. Small portions of the downtown area also experience occasional backups, especially along Spokane Falls Boulevard, Riverside and adjacent ot the railroad tracks (based on generalized mapping prepared by the Spokane City Department of Public Works).

The potential public health problems linked to backup and spillage of untreated sewage include a wide range of bacterial and viral maladies. Infections could include dysentery, infectious hepatitis, typhoid, staph infection, shigella and others. Tape worms, roundworms and amoebic dysentery can also be transmitted through sewage. However, discussions with the Spokane County Environmental Health District (Prather, pers. comm.) indicated they have not received reports of human illness related to contact with sewer backups. The health threat comes primarily from direct contact with the backup, but overflows also increase the possibility of water supply contamination. It would normally take an unusual set of circumstances for this wastewater to enter water supply piping, but if negative pressure in water lines were to coincide with flooding, wastewater could be drawn into basement water fixtures.

Each of the major CSO control options analyzed in the Spokane Facilities Plan includes a method of relieving this backup problem. The storage and satellite treatment alternatives (Alternatives 1 and 2) provide for construction of about 55 miles of relief sewers. These would be scattered throughout the city and would be placed parallel to existing undersized lines. The relief sewers would be sized to provide a combined new and existing pipe capacity sufficient to carry the 25-year-frequency storm. This would eliminate backups in all but the most severe storm that could be expected in a 25-year period.

The Latenser Plan, which modifies the city's storage alternative, did not originally include relief sewers. It was designed primarily to eliminate or reduce overflows to the river. However, for purposes of this EIS analysis relief sewers were added so that this alternative would respond to the city's desire to eliminate basement flooding. Therefore, the Latenser Plan would reduce the public health threat from sewer backups to the same degreee as Alternatives 1 and 2.

The Klicker Plan proposes to solve the backup problem by constructing gate valves and small storage basins on the sewer laterals of each structure currently affected by backups. This system prevents backups by restricting reverse sewage flow from trunk lines. It eliminates the backup in structures with gate valves, but does not relieve the hydraulic overloading of trunk sewers. Therefore, there is the chance that the overflow might simply be relocated to an upstream section of the trunk system. This relocation effect would vary from one area to the next, but would have to be considered before installing gate valves on a large number of laterals. The exact number of individual control systems needed is not known because a complete count of affected structures has not been made. However, Mr. Klicker suggests that about 700 units would have to be installed. If properly constructed and maintained, the gate valve-storage basin systems should eliminate backup-related public health threats at the homes receiving the new systems.

The city's Alternative 3 would solve the backup problem by providing separate storm sewers for the entire city. This separation of storm runoff and sanitary wastewater would eliminate all storm-related sewer backups. It would also require construction of about 220 miles of new pipeline. Construction of these lines would be phased over a considerable period of time so all backups would not be relieved immediately. Total construction period estimates are as high as 10 years.

Under the Combination Concept, drainage areas 1, 2, 3, 4, 7, 9, 11 and 13 (Figure 2-7) would receive separate sewers to solve the backup problem. Drainage areas 5, 6, 8, 10, 12, 14 and 15 would be provided with relief sewers to eliminate basement flooding. The effectiveness of these control measures was discussed above for Alternatives 1 and 3.

If outlying county areas were connected to the city system under Alternative 3, this would have little or no influence on the elimination of sewer backups as long as the connections were made into lines with sufficient hydraulic capacity.

The no-action option perpetuates the existing situation. Backups and basement flooding would continue during intense storms unless some type of control action was taken by the individual homeowner. The public health threat would also remain.

In summary, Alternative 3 appears to provide the greatest protection from the sewer backup and basement flooding problems experienced in Spokane because it completely removes storm runoff from the sanitary sewer system. Alternatives 1 and 2 and the Latenser option could provide major protection through construction of relief sewers, but backups could still occur under the most severe precipitation situations. The Klicker Plan would provide backup protection to those structures known to have an existing problem, but in some instances the health threat may simply be relocated.

Long-Term Effect of Alternatives on Beneficial Uses of the Spokane River and Land Adjacent to the River

Introduction

The Spokane River and adjacent lands below the City of Spokane are a major source of recreation for local residents and visitors to the area. River flows are used for power generation and to supply water for industry. Whether these beneficial uses will be affected by alternative plans for abatement of CSO is discussed based on interviews with individuals representing the various uses.

Figure 4-6 at the end of this discussion plots the seasonality of the various beneficial uses and also indicates the frequency of storm events and of combined sewer overflows under a design criterion allowing one overflow per year.

Water-Contact Recreation

Swimming and Water Skiing. Although some water skiing enthusiasts might extend the season somewhat by braving cool air and cold water in wet suits, most in-water activities are confined to the warmer summer months of July and August (Figure 4-6). Underwater currents, whirlpools and cold water temperatures make the free flowing portion of the Spokane River between the city and Long Lake dangerous for swimmers.

When materials commonly flushed down toilets appear along the shores and within the backwaters of the lake, recreationists are reluctant to enter the water. A strong "sewage odor" often accompanies the appearance of this waste matter (Phillips, et al., pers. comm.). According to Long Lake residents, their physicians blame lake water for recurrent eye and ear infections and rashes. Posting of the lake and newspaper warnings of toxic conditions have created for some the impression that the water is totally unsuitable for body-contact recreation.

Each of the proposed CSO alternatives would significantly reduce the present health hazards and aesthetic problems now associated with swimming and other water-contact recreation. Implementing Alternative 1 would reduce overflows to one per year or one per 25 years on the average, depending upon the design adopted. Both possible designs represent major reductions from the present overflow rate of approximately 80 per year. Alternative 3 and the Klicker Plan would eliminate essentially all CSOs to the Spokane River. Stormwater would still reach the river under Alternative 3, though, and could introduce surface runoff pollutants such as heavy metals, oil and grease, sediment and an array of organic materials. The Latenser Plan allows for one CSO per year. No overflows would be removed under Alternative 2, but all would receive primary treatment. Screening and chlorination would remove trash, floatables, etc., and kill most bacteria. Suspended solids may still enter the river and decrease water clarity. Even with chlorination, pathogenic viruses and resistant parasitic organisms could cause risks to public health.

The source of odors on the Spokane River (especially at Long Lake) is unknown. The decay of organic material, partially represented in Table - as BOD_5 may be a possible cause. All CSO abatement alternatives would remove about 12 to 17 percent of the total BOD_5 load now discharged by the city, (except the Latenser Plan, which would remove 99.9 plus percent). Whether the reduction by any but the Latenser Plan would be a significant part of the total organic load, or whether the decay of the city's CSO organics is causing the odor problems is unknown. It may be that the odor is associated with the decay of algae or other aquatic life.

The waters of Long Lake have become toxic during blooms of blue-green algae (Anabaena flos-aquae). If phosphorus or nitrogen are limiting, the amount of both nutrients that any of the CSO alternatives would remove (Table 4-6) is considered insufficient to affect any significant reduction in present levels of eutrophication.

Rafting, Canoeing and Kayaking. The most enthusiastic members (15 to 20 persons) of the White-Water Northwest Kayak Club use the Spokane River year round (Spokane City Department of Public Works, 1977 Appendices). A maximum of 40 members use the river from March to September (Figure 4-6). The Bowl and Pitcher area and the section between Maple Street and Fort Wright Bridge receive the most use.

Spokane River Expeditions provides rafting runs from Glover Field (near Monroe Street) to the Rifle Club Road area. Most of this rafting occurs from June to September (Staves, pers. comm.).

Eastern Washington University Recreation Department uses the Spokane River for rafting and canoeing. About 16 people canoe near Nine Mile Dam, and 35 to 45 people raft in the Bowl and Pitcher area six or seven times each year (Spokane City, Department of Public Works, 1977, Appendices).

Running the river in rafts or inner tubes is popular with visitors to Riverside State Park. Users put in upstream from the park and either float through or get out at the riverfront campground (Heiser, pers. comm.).

Present water quality apparently has little impact upon rafting, canoeing and kayaking, according to sources contacted. Thus, eliminating trash and improving water clarity would be desirable but wouldn't necessarily increase the use of the river.

Scuba Diving. Instructors at the Spokane Scuba School report that a few people float from above Spokane to Riverside State Park using snorkle and mask, and they occasionally spear fish. Most diving occurs above the city (Wilson, pers. comm.).

Those persons now snorkling in the Spokane River have not been discouraged by CSOs or by the county health department. Whether use by scuba divers would increase under the proposed alternatives was not speculated upon.

On-Water Recreation

Boating. Given favorable weather, residents of Long Lake would boat from March or April until November (Phillips, et al., pers. comm.). Both sailboats and motor boats are used on the lake.

Algae and aquatic weeds create most of the problems for boaters. Algae accumulates on the submerged portions of boats and can be removed only by heavy scouring. Boat lifts have been purchased by several individuals to avoid this problem; others refuse to launch their boats now. Aquatic weeds fill the quiet bays and tend to restrict the boating area. As mentioned earlier, the algae and weeds result to a large extent from general nutrient loading which cannot be directly attributed to CSOs.

Fishing. Bass fishermen use Long Lake from spring thaw (March) to winter freeze (November), although year-round fishing is allowed below Mission Street. Approximately 300 persons are members of bass fishing clubs within the Spokane area. Several catch-and-release tournaments with up to 80 participants are held each year at Long Lake (Parish, pers. comm.).

The Washington State Federation of Bass Clubs has traditionally supported the practice of high nutrient loading into Long Lake. More nutrients have meant more productivity, i.e., bigger bass in a shorter time (Parish, pers. comm.). Individual fishermen have expressed disgust at the sewage wastes which occasionally accumulate in backwaters and along shores from Willow Bay to Long Lake Dam during summer (Burns, pers. comm.). Sewage wastes from the City of Spokane would rarely or never appear in the water or along the shorelines of Long Lake if any of the CSO alternatives were implemented. The overflows represent such a small part of the total nutrient load on Long Lake that they should not impair the bass fishery.

Decreased use of Long Lake for bass fishing tournaments and fishing in general is attributed to an increase in squawfish and other rough fish, and to insufficient boat launching facilities. Most fish are released during tournaments, so edibility is of little concern. Long Lake residents, however, are reluctant to eat fish from the lake (Phillips, et al., pers. comm.). This reluctance is based upon a general distrust of the lake's water quality. Complete trust may not be restored until algal blooms disappear from the lake, a feat beyond the capability of CSO abatement. Certain species of blue-green algae may impart an unpalatable flavor to fish. Although flavor tainting was not mentioned in the interviews it may be a factor in an apparent reluctance to eat fish from the lake.

Ice Skating. From around December through February, Long Lake residents enjoy ice skating on the frozen lake. Combined sewer overflows have apparently not affected this use.

Hunting. Duck hunting season in the Spokane area extends from mid-October to mid-January. Approximately 30 to 50 hunters can be found on Long Lake on a weekend during hunting season (McCalgen, pers. comm.).

Adopting any of the proposed alternatives would not alleviate the duck hunters principal problem, the shifting of the flyway west and away from Spokane (Miotke, pers. comm.).

Shoreline Activities

Camping and Picnicking. Riverside State Park contains 5,543 acres with 44,000 feet of river frontage. Attendance figures compiled for camping and day use at the park in 1976 and 1977 show May, June and July as the most popular months, with April and August still receiving heavy use (Heiser, pers. comm.). Visitors to the park totaled 690,082 and 851,987 during 1976 and 1977, respectively.

Signs are posted in state campgrounds adjacent to the river warning "Do Not Drink Water or Use for Washing". The boat launch has been closed periodically when the lake was posted by the Spokane County Health Department during toxic algal blooms. Nevertheless, a very small increase in use of Riverside State Park is anticipated if factors such as health hazards, streamside aesthetics, turbidity and smell, and algal blooms were improved (Heiser, pers. comm.). All of the CSO alternatives should reduce these problems except, perhaps, the algal blooms which have not been conclusively linked with CSO loading.

Scenic Driving, Hiking, etc. Driving along the parkway and roadway which border the Spokane River within Riverside State Park is one of the important uses of the shoreline area. Many park visitors enjoy the scenic overlooks offered along the route (Heiser, pers. comm.).

Other facilities available in the state park are hiking and horseback riding trails, a firing range and off-road vehicle use areas.

Park officials feel that these shoreline activities would not be increased by the elimination of combined sewer overflows. Trash, floatables, turbidity and odor apparently do not now detract from the enjoyment of these uses.

Many Long Lake residents no longer walk their dogs along shoreline areas because they fear for their animals' health (Phillips, et al., pers. comm.). According to the office of Fredrickson, Maxey, Bell & Stiley, several dog deaths have been linked to ingestion of toxic algae from the lake (Delfeld, pers. comm.). Because the abatement of CSOs probably will not measurably affect algal blooms, this problem may continue for dog owners.

Bird Watching. Bird watching is very productive during spring along the shorelines at Long Lake and above Nine Mile in Riverside State Park (Hagen, pers. comm.).

CSOs apparently create no problem for this use.

Golfing. Golfers can see the Spokane River from the clubhouse and various other points of the Downriver Municipal Golf Course (Korff, pers. comm.). Changes in water quality would not be noticeable from this distance.

Economic Uses

Resorts and Restaurants. During 1975, Long Lake supported three resort areas: Sportman's Paradise, Willow Bay Resort and Tumtum. Sportsman's Paradise no longer operates, but the latter two are open year-round with camping occurring from April to October.

Willow Bay Resort grossed approximately $60,000 per year during the early 1970s and was gaining roughly $10,000 to $20,000 annually (Thom, pers. comm.). Yearly gross income is now about $40,000. Mr. Thom, owner of the resort, blames this loss of business on the bad image given to Long Lake by publicity on the October 1975 bypass, on algal blooms during 1976 and 1977, and on overflows during storm events. Very few of his regular customers (before 1975) return now. Resorts at other lakes within the Spokane area are often at capacity while his is never filled.

Sportman's Paradise was closed by the owner on his own accord October 3, 1975 when sewage was bypassed to the river while the new treatment plant was being put into operation (Miotke, pers. comm.). From 1969 to 1974, Mr. Miotke invested roughly $140,000 in this resort. Gross returns rose from about $8,000 in 1969 to $35,000 in 1975. State jamborees were once held at Sportsman's Paradis and nearly 3,000 visitors attended a weekend boat race during 1974. Mr. Miotke felt that the health hazard in the lake after the 1975 bypass was sufficient reason to close his resort.

Sunset Bay Restaurant has also reportedly suffered from the bad image given Long Lake by press coverage of the bypass, algal blooms and overflows. Fewer people now visit the lake; this reduces restaurant use (McCullough, pers. comm.). Business was cut in half during the algal blooms when homeowners across the lake, worried about the algae and hampered by macrophyte outbreaks, wouldn't boat across to dine out. The restaurant owners have abandoned plans to invest in construction of a laundromat and hardware store at their present site.

Mitigating CSOs should help dispel the image of raw sewage being discharged into the river and entering Long Lake. The lake's eutrophic condition and associated algal blooms, however, are the result of more than just overflows. Any improvement in water quality coupled with favorable publicity should bolster the success of shoreline resorts.

Property Value. Mr. William Main, a real estate broker and developer in the Spokane area, has developed and is developing several thousand acres of property adjacent to Long Lake. He testified that the October 1975 sewage bypass and the 1976 and 1977 toxic algal blooms had no adverse impact upon the market value of this property or upon his ability to sell this property in the Spokane real estate market (Miotke v. City of Spokane, 1977).

Power Generation. Washington Water Power operates a series of hydroelectric structures on the Spokane River. The present quality of surface water does not interfere with the generation of power (Vaughn, pers. comm.). The only possible CSO abatement conflict with power production would be export of Spokane's wastewater as proposed in the Latenser Plan. Washington Water Power Company has rights to generate electricity with all water in the river up to its generator's capacity (O'Kelley, pers. comm.). Therefore, removal of the treatment plant flow from the river during low flow conditions could theoretically reduce WWP's generation capabilities. The actual reduction in flow would be quite small, however, (60 cfs) and some agreement could probably be reached between Spokane and WWP with regard to any export.

Industrial and Agricultural Uses

Industrial Uses. The only significant withdrawal of surface water from the Spokane River is for industrial purposes. Annual consumptive use is 2,372 million gallons (10 cfs) while diversion by Kaiser Trentwood is 6,387 million gallons (27 cfs; U. S. Army Corps of Engineers, 1976; Appendix C). This water is withdrawn above most of the outlet pipes for combined sewer overflow.

Agricultural Uses. Surface water used for agricultural irrigation is taken from the Little Spokane River, and its tributaries (U. S. Army Corps of Engineers, 1976; Appendix C). CSOs, therefore, have no impact upon this use.

Spokane River water below the city and above Long Lake Dam is not used as a water supply for commercial livestock. However, riding stables are maintained (near Seven Mile Dam), and cows graze near Nine Mile Dam (Soltero, pers. comm.). As of June 1977, Dr. Pidlake, head of the Animal Health Division of the Washington State Agricultural Department, knew of no documented cases of animal sickness related to the drinking of river water below the City of Spokane (Spokane City Department of Public Works, 1977; Appendices).

Uses Downstream from Long Lake Dam

Spokane Indian Reservation. The Spokane Indian Reservation consists of about 150,000 acres of land and is bounded on the south by 30 miles of the Spokane River from Chamokane Creek to the Columbia River. The tribe uses the Spokane River for hunting, fishing and other recreation as well as irrigation and livestock watering (Spokane City Department of Public Works, 1977; Appendices).

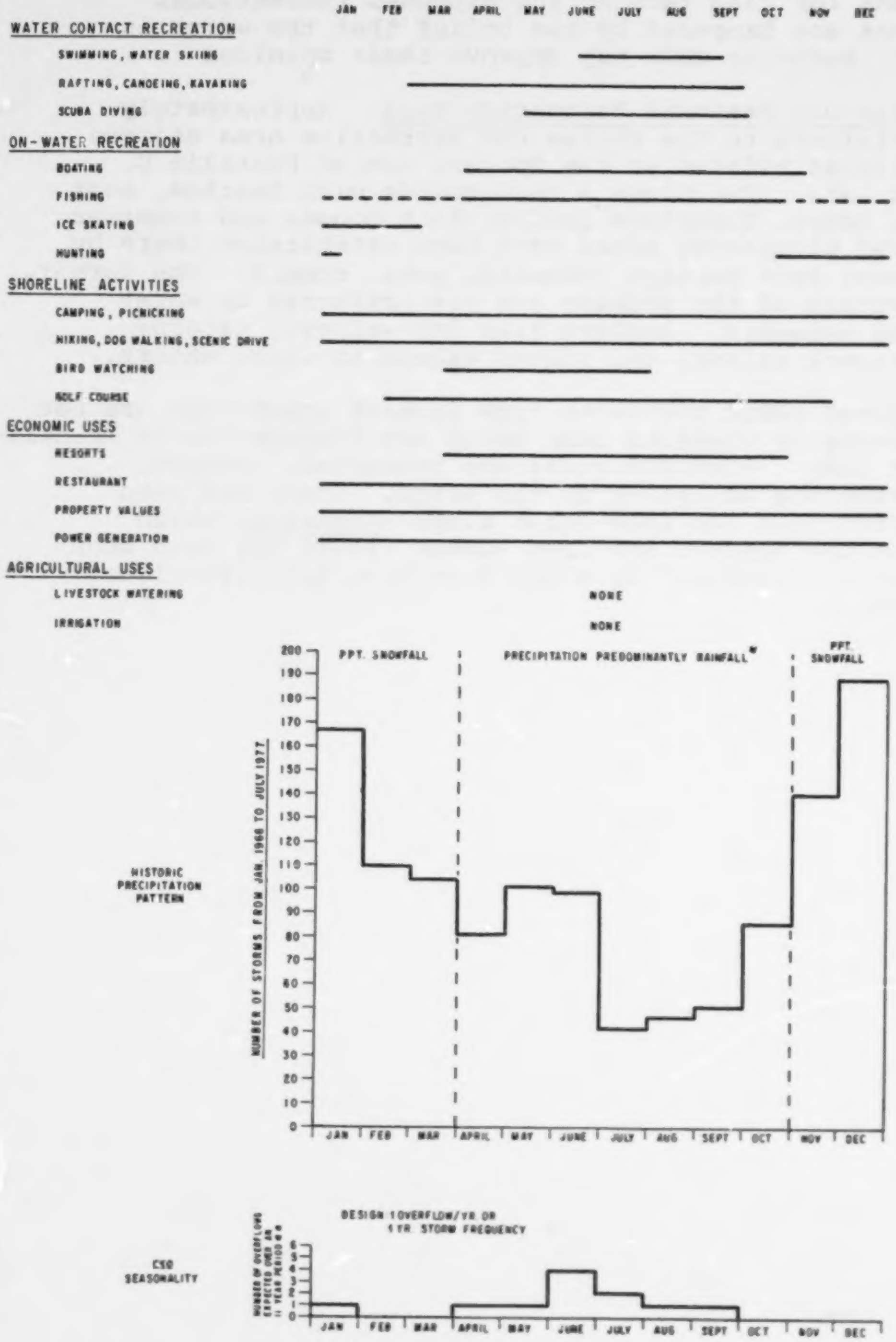
The Spokane Indians have traditionally been concerned that sewage from the City of Spokane be removed from the river. This concern extends now to the elimination of overflows during storms (Dellwo, pers. comm.). Tribal use of the river for fishing and domestic water supply and their plans for fish farming and expanded recreational development are hampered by the belief that the water is polluted. Reducing CSOs may improve their opinions.

Coulee Dam National Recreation Area. Approximately 150,000 visitors to the Coulee Dam Recreation Area enjoyed the facilities offered at the Spokane Arm of Franklin D. Roosevelt Lake. Two Class A campgrounds with beaches, boat launching ramps, fireplace grills, bath houses and numerous camping and picnicking sites have been established there by the National Park Service (Dunmire, pers. comm.). The warmer, quieter waters of the Spokane arm are preferred by water skiers and swimmers. Anglers fish for walleye, rainbow trout, chinook salmon, and silver salmon in these waters.

Combined sewer overflows from Spokane apparently are not now discouraging visitors from using the Spokane Arm of Franklin D. Roosevelt Lake. Park officials are concerned, however, about preventing pollution of the water. There has been some concern that the blue-green algae (Anabaena) which bloomed in the Spokane Arm last summer (1978) may have been the result of "seeding" by algae from Long Lake (Sterling, pers. comm.).

FIGURE 4-6

SEASONALITY OF BENEFICIAL USES OF THE SPOKANE RIVER IN RELATION TO AREA PRECIPITATION & POTENTIAL CSO EVENTS



* U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION, 1976

** BASED ON ACTUAL OVERFLOW EVENT DATA COLLECTED 1966 TO 1977

Influence of Alternatives on Spokane River Tributaries

Introduction

Hangman Creek and the Little Spokane River are the major tributaries entering the Spokane River between the Idaho border and Long Lake Dam. Hangman Creek enters at Highbridge Park, 72.4 miles above the mouth of the Spokane River. The river becomes Long Lake where the Little Spokane enters 56.3 miles above the mouth.

Hangman Creek

A single outfall from Spokane's combined sewer system discharges into Hangman Creek approximately 4 miles above the creek's confluence with the Spokane River. CSO abatement would substantially decrease (Alternative 1 and Latenser Plan), eliminate (Klicker Plan), or improve the quality of (Alternatives 2 and 3) overflows from this outfall.

Because most of the water quality monitoring programs have involved sampling below the CSO discharge point into Hangman Creek, it is difficult to evaluate the changes CSO abatement would effect. High nitrogen and phosphorus levels have been recorded in the creek, but no studies have been conducted to determine the exact source of the nutrients.

CSO suspended solids additions to the creek represent a minor impact upon Hangman Creek compared to the heavy sediment load introduced by erosive soils during rainy seasons; CSO abatement would be beneficial but not vital to the improvement of its quality.

Little Spokane River

Only Alternative 3 (separate storm sewers) could affect water quality in the Little Spokane River, but effects could be significant. Although no overflow from the City of Spokane now enters this tributary, Kennedy Engineers (1978) indicate that sewage from small individual treatment systems in the North Spokane area probably does. Sewer separation within the city would increase the capacity of the Spokane sewage treatment plant to accommodate flows from other areas within the region, e.g., North Spokane. The elimination of oxidation ponds and individual septic tanks near the Little Spokane River would probably decrease direct and indirect (through groundwater discharges to the river) contamination of the tributary.

Effects of Wastewater Importation on the Crab Creek Drainage

Crab Creek is a major drainage in east central Washington with a total watershed of approximately 4,250 square miles. Its headwaters are located 25 miles west of Spokane near the community of Reardan. The stream flows southwest and then west across Lincoln County and into Grant County, where it turns abruptly south and enters the Parker Horn of Moses Lake. After passing through control structures on both Moses Lake and Potholes Reservoir, Crab Creek flows west into the Columbia River a few miles upstream of Priest Rapids Dam (Figure 4-7). The major communities in the basin include Reardan, Canby, Edwall, Odessa, Irby, Marlin, Wilson Creek, Stratford, Adrian and Moses Lake.

Because the Crab Creek basin is considered water short and the expansion of irrigated agriculture has started to overtax both surface and groundwater supplies, Spokane engineer (James Latenser) developed a proposal to export Spokane treated wastewater to the Crab Creek drainage to augment local water supplies. This Plan (Latenser Plan) is described in some detail in Chapter 2. In brief, Spokane's wastewater would receive biological secondary treatment, be piped to the headwaters of Crab Creek near Reardan and discharged to the creek. From the point of discharge, wastewater would flow down the creek toward Odessa where it would be diverted for agricultural uses. The wastewater could be discharged 365 days a year at a rate of 39 million gallons per day (mgd) at the outset. No specific location for agricultural reuse has been described, but there are sizable areas of irrigable land within 1/2 mile of the creek, especially in the Odessa area.

The flow regime in Crab Creek varies considerably both with season and location. It is generally perennial upstream from Odessa, but often dries up in summer and fall between Odessa and Wilson Creek. It resurfaces near Wilson Creek and maintains surface flow into Moses Lake. The U. S. Geological Survey maintains stream gauging stations on the creek at Irby and just above Moses Lake (Figure 4-7). Annual average flows at Irby are 79 cubic feet per second (cfs) or 57,090 acre-feet. Flow rate extremes are 8,370 cfs (in 1957) and no flow for several consecutive days (in 1969). During the 1975-76 water year, instantaneous discharges at Irby varied from 6.4 cfs in August to 1,930 cfs in February (U. S. Geological Survey, 1977).

Crab Creek frequently floods above Moses Lake. Its floodplain is quite flat and broad below Odessa which encourages local flooding during peak winter and spring runoff. A detailed study of flood locations and frequencies has not

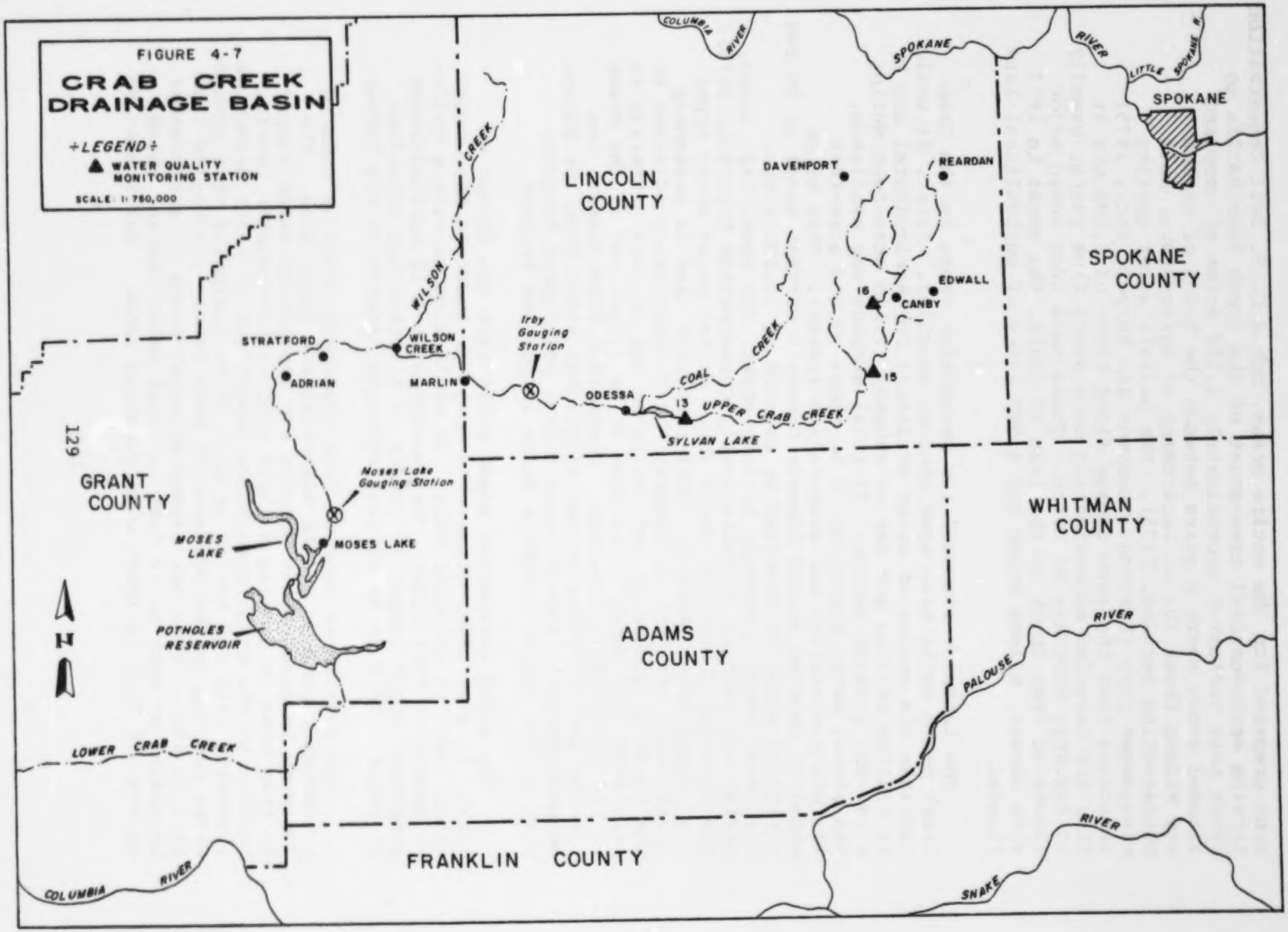


FIGURE 4-7

CRAB CREEK DRAINAGE BASIN

÷LEGEND÷
▲ WATER QUALITY MONITORING STATION
SCALE: 1:750,000
LINCOLN COUNTY
SPOKANE COUNTY
GRANT COUNTY
ADAMS COUNTY
WHITMAN COUNTY
FRANKLIN COUNTY
SPOKANE
DAVENPORT
REARDAN
EDWALL
CANBY
16
15
13
STRATFORD
ADRIAN
WILSON CREEK
MARLIN
ODESSA
MOSES LAKE
Irby Gauging Station
Moses Lake Gauging Station
WILSON CREEK
COAL CREEK
UPPER CRAB CREEK
SYLVAN LAKE
MOSES LAKE
POTHOLES RESERVOIR
LOWER CRAB CREEK
COLUMBIA RIVER
SPOKANE RIVER
LITTLE SPOKANE R.
PALOUSE RIVER
SNAKE RIVER
N

been prepared for the entire creek, but a U. S. Soil Conservation Service environmental assessment of the creek from Marlin to Brook Lake indicated approximately 1,100 acres of cropland flooded about every 2 years between the Towns of Marlin and Wilson Creek (U. S. Department of Agriculture, Soil Conservation Service, 1975). The basin's water quality management plan (Stevens, Thompson and Runyon, Inc., 1975) indicates that the zero damage flood flows of 3,000 cfs at Irby are exceeded approximately once every five years, usually in January, February or March. There have been seven major floods on Crab Creek in the last 50 years, the worst in 1957 with Odessa, Wilson Creek and 8,500 acres of agricultural land flooded.

The Latenser proposal for wastewater reuse in the Crab Creek basin could have some obvious benefits. First, it would increase the amount of water available for agricultural use by 40 million gallons per day or roughly 17,200 acre-feet during a 140-day growing season. If total storage was available, the annual water supply would be about 45,350 acre-feet (before percolation and evaporation losses). This water could be used to expand Lincoln County's current total of 50,000 irrigated acres of cropland by as much as 10,000 acres. Irrigated crops currently include wheat, dry peas, hay, beans, barley and pasture (Lincoln County Conservation District, 1978). The expanded irrigation could occur at any point along upper Crab Creek below Reardan. Most irrigated land is presently found south and west of Odessa. Land immediately adjacent to the creek is generally not irrigated and is used primarily as rangeland; the water would have to be lifted out of the creek to the surrounding cropland. Downstream from Odessa, the farmers are expecting to get additional water from the Bureau of Reclamation's second Bacon Tunnel and Siphon Project, part of the larger Columbia Basin Irrigation Project.

The added irrigation water would give the farmer an option to grow crops other than wheat or increase the annual yield from his existing crop. It would also provide a built-in source of fertilizer. Wastewater with a 10 mg/l nitrogen component would supply 27 pounds of nitrogen per acre-foot of water. This is an obvious economic benefit to the farmer.

One additional benefit from the reuse could be reduced groundwater pumping in the Odessa-Wilson Creek area. The increase in groundwater pumping for irrigation water supply in that area is causing a rapid drop in groundwater levels. Studies by the Washington State Department of Water Resources (Garrett, 1968 and Luzier et al., 1968) indicated that groundwater pumping in the Odessa-Lind area nearly quadrupled from 1963 to 1967. This has caused seasonal drops in groundwater levels of as much as 12 feet in upper water-bearing zones to over 50 feet in lower water-bearing zones. Wells must be continuously deepened where the drops are not regenerated by subsurface inflows. Currently, many of the agricultural wells in the Odessa area are 1,500 feet deep (Dompier, pers. comm.). If the new source of surface water were used to replace groundwater pumping, the amount of overdrafting could be reduced.

The Latenser export scheme also has some potential drawbacks relating to the Crab Creek drainage. Those with most direct influence on its implementability are potential conflicts with state laws and regulations that are designed to protect and improve the quality of Washington's surface waters. The Washington Department of Ecology has classified Crab Creek as a Class B stream. According to the Washington State Water Quality Standards, this means the water quality must be maintained sufficient to support most potential uses except domestic water supply, swimming, and water skiing. The appropriate uses include agricultural water supply, stock watering, fishery and wildlife habitat, and general recreation (fishing, picnicking, boating). The water quality criteria for Class B streams are summarized below:

WATER QUALITY CRITERIA
CLASS B STREAMS

Parameter	Freshwater Standard
Fecal coliform organisms	200/100 ml
Dissolved oxygen	>6.5 mg/l or 70 percent saturation
Total dissolved gas	<110 percent saturation
Temperature	<21.0°C
pH	6.5 to 8.5
Turbidity	<10 NTU over background or 20 percent increase

In addition to these standards, toxic radioactive or deleterious material concentrations must be kept below levels that would adversely affect the characteristic water uses mentioned above or public health during characteristic uses. Aesthetic values cannot be reduced by dissolved, suspended, floating or submerged matter not attributed to natural causes so as to affect water use or taint the flesh of edible fish species (Washington Department of Ecology, 1977).

The anticipated quality of the secondary effluent discharged to Crab Creek would probably meet most of the Class B water quality standards with the exception of aesthetics and toxic and deleterious materials. These two categories are fairly subjective in nature and would be subject to interpretation by the Washington DOE. Discussions with

Rhys Sterling of DOE's Spokane office suggested the aesthetic and toxic and deleterious areas would be of concern. The possibility of dissolved oxygen sags brought on by the wastewater nutrient load was also voiced as an area of concern (Sterling, pers. comm.). The water discharged to Crab Creek would contain 10 to 15 mg/l of $NO_3 + NH_4$ and approximately 6 mg/l of phosphorus. BOD loading would be in the neighborhood of 17 mg/l. The present quality of upper Crab Creek is not well documented, but grab samples analyzed by the U. S. Bureau of Reclamation (reported in Stevens, Thompson and Runyan, 1975) in 1972 showed most quality parameters to be well below Class B standards. Table 4-8 below summarizes the Bureau of Reclamation data.

Table 4-8

CRAB CREEK WATER QUALITY

Parameter	Sampling Station[1] 13	15	16
DO (% saturation)	+90%	-	+85%
Turbidity (tu)	6	6	4
Total phosphorus (mg/l)	0.1-1.0	0.12-1.9	0.1-7.4
Nitrate (mg/l)	0.02-1.3	0.4-1.2	0.7-1.5
pH	7.7-8.5	7.6-8.3	7.2-8.7

[1] See Figure 4-5 for location of sampling stations.

The wastewater discharge would also conflict with DOE's Advanced Waste Treatment Policy (Washington Department of Ecology, 1972) which requires a 20 to 1 dilution ratio of average minimum stream flows to new wastewater discharges. Stream flows in the Crab Creek headwaters have not been measured over any extended period, but during the summer season they would be well below the 1,200 cfs required to provide a 20 to 1 dilution to the anticipated 39 mgd (60 cfs) wastewater discharge. The Latenser Plan discharge would have to be exempted from this policy constraint in order to operate as currently proposed.

The public health concerns created by transporting wastewater in Crab Creek would be two-fold. First, any direct human contact with or consumption of water out of the creek could cause illness. This would be especially true during the summer months when dilution by natural flows would be low and stream use would be at its greatest.

Bacterial and virus infections such as hepatitis, dysentery and shigella are commonly transmitted in wastewater. The wastewater would be disinfected to meet Class B stream standards (200 MPN/100 ml or less), but incidental contact through wading, fishing or swimming would still be a potential hazard. The other health threat could result from contamination of groundwater supplies. Crab Creek recharges a discontinuous aquifer that occupies sand and gravel lenses immediately adjacent to and below the creek. The depth and continuity of this aquifer has not been accurately mapped, but there is little doubt that Crab Creek feeds into it at various locations (Garrett, 1968). The number of domestic water supply wells tapping this aquifer is not known, and the relationship of this aquifer to deeper basalt aquifers which furnish the area's primary water supply has not been determined. Although a health threat cannot be identified without further investigation, the potential health hazard is extreme and may not be acceptable to state and local public health officials. The Latenser Plan, in effect, exports a water quality-public health problem from the Spokane River and relocates it in Crab Creek.

The discharge of 39 million gallons of water per day into Crab Creek during heavy rain periods could increase the threat of flooding in downstream areas. As mentioned earlier, Crab Creek floods quite frequently. The 39 mgd represents an average flow of 60 cfs; a flow of 3,000 cfs is considered zero damage flood stage on Crab Creek at Irby. Flows above 3,000 cfs result in flooding. It would take a much lower flow to create local flooding higher up on Crab Creek, between Odessa and Reardan. Therefore, it may be desirable to be able to discharge to the Spokane River or to have some wastewater storage capability to avoid discharge to the creek during periods of flood threat.

Upper Crab Creek does not receive a heavy amount of recreational use, but there is some fishing for brown trout in the upper reach. Trout fishing could be diminished if wastewater discharges in low flow periods result in major oxygen sags. Trout are highly sensitive to dissolved oxygen levels and adverse effects could be expected if dissolved oxgyen levels drop below 5 parts per million (ppm) for any extended period of time. It is not possible to predict the actual threat of dissolved oxygen depletion without modeling the stream, and there are insufficient base data for this. However, the low levels of dilution that would be afforded the wastewater discharge in summer low flow periods suggest oxygen depletions are possible.

Other uses of Crab Creek are not likely to be adversely affected. The creek acts as a water source for range cattle most of the year and the antipicated quality of the waste discharge should be sufficient to support this use. However, if dairy cattle are to utilize this water source, the disinfection must be sufficient to reduce total coliform to 23 (geometric mean) per 100 milliliters (state guidelines for land disposal of treated domestic sewage effluent; Washington Department of Ecology, 1976).

Two additional potential problems are raised by expansion of irrigation along upper Crab Creek. First, much of the surrounding agricultural land is on sloping terrain, and irrigation of the steeper slopes can increase soil erosion significantly (Dompier, pers. comm.). Most of the irrigated soils are deep, wind-deposited silt loams and under heavy rainfall or sprinkler irrigation conditions they are easily washed downslope. Second, some area farmers have expressed the fear that irrigation projects increase production costs while increasing yields; the increased yields can flood local markets and thereby decrease prices received for the crops (McBride, 1978). Whether this feeling is widespread among Lincoln County farmers is not known.

Most of the adverse implications of the Latenser reuse scheme relate to the change in water quality it would exert on Crab Creek. There are a number of ways this change could be eliminated or at least reduced, but they require major adjustments in the scheme's design. If the wastewater were transmitted down the Crab Creek drainage in a pipe rather than in the creek, the water quality problems would obviously be eliminated. This would add a major new cost to the project however, and would probably make it economically unacceptable. Another remedy would be to increase the level of treatment prior to discharge to the creek. Additional BOD, suspended solids and bacteria/virus removals would be desirable, but this again would add significantly to project costs. If storage were added after treatment, discharges during extreme low flow or high flow conditions could be eliminated, ensuring some control on dilution and avoiding discharge during flood periods.

The public health threats are most readily controlled by improved water treatment and disinfection, as mentioned above. Other mitigation could include relocation or deepening of all domestic wells drawing water from shallow aquifers along Crab Creek.

Impacts on the Crab Creek fishery could be avoided by using pipe transport rather than the creek channel, or by increasing the treatment level. Removal of as much of the organic matter as possible would be desirable. This would also remove the wastewater's fertilizer value. If wastewater discharges to the creek were limited to high natural flow periods (through storage), the likelihood of dissolved oxygen sags would be reduced. All of these remedies would add significantly to the cost of the project.

The potential soil erosion associated with sprinkler irrigation can be avoided by limiting the irrigation to relatively flat acreages. This would require selective distribution of the new water source. The U. S. Soil Conservation Service and the County Agricultural Extension Service can also provide information on farming practices that help control sprinkler-related soil erosion.

Groundwater Quality Implications of Alternatives

There is some concern that contaminants in Spokane's combined sewage overflows could be transferred to groundwater supplies downstream from the City of Spokane. Studies of the Spokane Valley-Rathdrum Prairie aquifer provide the best available information on quality and hydrology of groundwater in the vicinity of Spokane. The findings of several of these studies are summarized below.

The most thorough study of the aquifer completed to date was prepared by Drost & Seitz (1978) for the U. S. Geological Survey. Their findings indicated that only manganese and phenols occurred in excessive levels in groundwater downstream from Spokane. Unacceptably high levels of these contaminants occurred in relatively few of the water samples analyzed in the study. Manganese exceeded the National Proposed Secondary Water Regulations (U. S. Environmental Protection Agency, 1977) standard of 0.05 mg/l in 12 of 700 samples. Phenols exceeded the U. S. Public Health Service (1962) standard of 0.001 mg/l for drinking water in 18 of 77 samples. No other groundwater contaminants were noted by Drost & Seitz. The current water supply quality standards established under the National Interim Primary Drinking Water Regulations (U. S. Environmental Protection Agency, 1975) no longer list phenols in the hazardous substances category. The source of these two contaminants is unknown, but it is unlikely that they are transmitted to the aquifer from CSOs. Neither manganese nor phenols occur in high concentrations in typical combined sewage overflows. Phenols are frequently used by industries located east of Spokane, but no direct link to aquifer contamination has been uncovered to date.

Other studies of the aquifer have considered the transfer of coliforms from the surface to groundwater supplies. Studies by Phillips, et al., (1968) concluded that soils in the Spokane Valley are capable of filtering out virtually all coliform bacteria leached downward from the surface before it can reach the groundwater 40 to 100 feet below. This does not eliminate the possibility of transferring contaminants through well holes or other unimpeded routes downward. Randall (1970) suggests that coliform bacteria can travel as far as 180 feet horizontally upon reaching a water table. Therefore, there is the possibility that coliforms or other contaminants could be transferred from the Spokane River to groundwater stores below Spokane where there is a direct interchange between surface flows and underground flows.

The Drost & Seitz report (1978) indicated there is a net flow of 120 cfs of groundwater into the Spokane River between Spokane and Seven Mile Bridge (on an annual basis); similarly, there is a 100 cfs net inflow to the river between Seven Mile Bridge and Nine Mile Bridge. This net exchange from the groundwater to the river indicates that transfer of CSO pollutants to the groundwater is unlikely, but not necessarily impossible. To date there have been no reports of groundwater contamination by coliforms along the river below Spokane. The 208 study of the Spokane Valley-Rathdrum Prairie aquifer now being conducted by the Spokane County Engineers should be continuously consulted for further information on groundwater quality below Spokane.

Alternative 3, which would allow eventual sewering of the Spokane Valley area to the City of Spokane wastewater system, could have an indirect positive influence on the quality of the Spokane Valley-Rathdrum Prairie aquifer. If Spokane Valley septic tank systems can be eliminated by connecting valley residents to the city sewer system this source of groundwater contamination would be eliminated. Waste materials leaching downward from the numerous valley septic tanks are believed to be a major threat to the quality of the underlying aquifer.

Costs of Alternatives and Probable Levels of Federal/State Grant Funding

Construction Costs and Cost Allocations

The construction costs of alternatives, expressed in 1978 costs, were previously presented in Chapter 2, when each individual alternative was discussed. These construction costs are summarized in Table 4-9, along with an estimate of the cost allocation between the U. S. EPA, the State of Washington, and the City of Spokane.

The assumptions which were used to develop the construction cost allocation are explained below for each of the alternatives.

Alternative 1 - Storage Basins - Storage Plan B and Klicker Suboption. All costs for relief sewers or on-site gate valves (Klicker Plan) were allocated to the City of Spokane, and storage basin costs were allocated 75 percent, 15 percent, and 10 percent to the EPA, State of Washington and Spokane, respectively.

Alternative 2 - Satellite Plants. All costs for relief sewers were allocated to City of Spokane, and satellite treatment plant costs were allocated 75 percent; 15 percent; and 10 percent to the EPA, State of Washington and Spokane, respectively.

Alternative 3 - Storm Sewers. Costs for storm sewers were allocated 66 percent to EPA, 13 percent to the State of Washington and 21 percent to Spokane; this was based on a determination that 87.8 percent of the multi-purpose project would be grant eligible.

Latenser Export Plan. Costs for relief sewers and for the export portion of the plan were allocated 100 percent to the City of Spokane. Costs for storm sewers, force mains, pipelines and storage facilities were allocated 75 percent; 15 percent; and 10 percent to the EPA, State of Washington and Spokane, respectively.

Combination Pollution Control and Drainage Concept. The cost of relief sewers, where they are required, was allocated to the City of Spokane. The cost of cost-effective storm sewers and storage basins was allocated according to EPA Program Guidance Memorandum Number 61.

Table 4-9

SUMMARY OF CONSTRUCTION COST ALLOCATIONS

Alternative	Total Construction Cost	Allocations		
		EPA	State of Washington	City of Spokane
1. City Alternative 1 - Storage				
Basins				
25 yr. frequency storm*				
Storage basins	72,800,000	54,600,000	10,920,000	7,280,000
Relief sewers	28,920,000	-	-	28,920,000
Total	101,720,000	54,600,000	10,920,000	36,200,000
1 yr. frequency storm**				
Storage basins	25,090,000	18,794,250	3,758,850	2,505,900
Relief sewers	28,920,000	-	-	28,920,000
Total	53,979,000	18,794,250	3,785,850	31,425,900
2. City Alternative 2 - Satellite Treatment				
Plants	66,899,000	50,174,250	10,034,850	6,689,900
Relief sewers	28,920,000	-	-	28,920,000
Total	95,819,000	50,174,250	10,034,850	35,609,900
3. City Alternative 3 - Separate sewers				
Storm sewers	64,050,000	42,170,000	8,430,000	13,450,000
4. Klicker Plan				
Storage basins & pipelines	59,538,200	44,653,650	8,930,730	5,953,820
Check valves & storage	1,000,000	-	-	1,000,000
Total	60,538,200	44,653,650	8,930,730	6,953,820
5. Latenser Plan				
Storm sewers & storage	41,152,400	30,864,300	6,172,860	4,115,290
Relief sewers	28,920,000	-	-	28,920,000
Export facilities	35,573,000	-	-	35,573,000
Total	105,645,400	30,864,300	6,172,860	68,608,240
6. Combination Concept				
Storm Sewers	5,630,000	4,222,500	844,500	563,000
Storage basins	21,534,000	16,150,500	3,230,000	2,153,400
Relief sewers	25,920,000	-	-	25,920,000
Total	53,084,000	20,373,000	4,074,600	28,636,400

* Each storage basin would be large enough to contain the maximum expected overflow created by all but the largest storm expected to occur in a 25-year period; statistically, this size of storm would have a 4 percent chance of occurring in any given year.

**Storage basins would be large enough to contain the flows of all but the largest storm normally expected to occur each year.

Public Maintenance Costs Associated with Alternatives

Alternative 1. Annual operation and maintenance (O&M) costs for any of the structural alternatives would be the responsibility of the City of Spokane. O&M costs would be the second highest with this alternative. It would be necessary to clean the storage basins after each use, which adds to maintenance requirements (Spokane City Department of Public Works, pers. comm.). Annual costs are estimated over the service life of the project. According to public works personnel estimates, one additional maintenance employee would be required for every $30,000 of O&M costs (Gellner, pers. comm.). This would require the employment of an estimated 26 additional maintenance personnel. There would be additional street maintenance costs due to relief sewer construction, but not to the extent estimated for separate storm sewers. This alternative would eliminate municipal costs for cleanup and repair of areas damaged by storm water and sewer backup.

Alternative 2. O&M costs associated with this alternative would result primarily from the extensive maintenance and monitoring required at the small treatment facilities and from the greater energy and chemical consumption. O&M costs are estimated at $2.50 per cfs of flow capacity or $474,700 annually over the service life of the project. This would require additional annual employment of an estimated 15 persons. Additional street maintenance costs due to relief sewers and costs savings due to elimination of sewage backup would be the same as Alternative 1.

Alternative 3. Annual O&M costs would be relatively low with this alternative. Annual costs are estimated at $700 per mile of storm sewer, or $152,930 annually over the service life of the project. On this basis, the project would require employment of five additional persons. This alternative would require more widespread disturbance of street surfacing than would either of the other two structural alternatives. The first year following construction in any street segment there may be some trouble with settling, necessitating releveling of streets. Patched streets may also require additional resurfacing. Additional costs over the 10-year construction period are estimated at $200,000 (Gellner, pers. comm.). This cost has not been included in average annual costs for this alternative. The alternative would eliminate maintenance costs now incurred by the city for periodic cleanup and repair of areas damaged by storm water and sewer backup. No estimate was available from the city as to annual average costs for this service.

Klicker Storage Suboption. O&M costs are the highest with this alternative and are estimated at $837,150 annually over the service life of the project. This would require employment of an estimated 28 additional maintenance personnel. Street maintenance costs due to relief sewers would not be incurred, but cost savings due to elimination of sewage backups would probably be the same as Alternative 1.

Latenser Plan. O&M costs are estimated at $587,900 annually over the service life of the project. This would require employment of an estimated 20 additional maintenance personnel. Street maintenance costs and cost savings due to elimination of sewage backups would be the same as Alternative 1.

Combination Concept. O&M cost are relatively high with this alternative and are estimated at $758,450 annually over the service life of the project. This would require employment of an estimated 25 additional maintenance personnel. Where separate storm sewer and relief sewers are planned, additional costs would be incurred for street maintenance. These additional costs would be significantly less than with Alternative 3, but greater than for Alternatives 1 and 2. This alternative would eliminate municipal costs for cleanup and repair of areas damaged by storm water and sewer backup.

No-Action. With this alternative there would be continuing public costs connected with cleanup and repair of facilities damaged by storm sewer backup. Annual damages are currently estimated at about $1,000,000 (James, pers. comm.). This estimate does not include the city expense of sending maintenance crews out to help pump out basements or clean up at backup sites. It is only an estimate of property damages and individual homeowners cleanup costs. No estimates were available from the city as to the actual amounts paid annually by the city to reimburse or compensate occupants for these damages.

Local Government Ability to Finance Alternatives

The city currently proposes to finance its CSO abatement project by a combination of federal and state grants (see discussion of cost of alternatives and probable levels of federal/state grant funding) and revenue produced from monthly user charges (James, pers. comm.). However, until the actual level of grant funding is determined, the precise method of funding cannot be determined, and may require other financing methods. This section will, therefore, deal with the major methods of financing available, and the existing debt or bonding capacity of the city.

Financing powers available to the city or a city-wide local improvement district (LID) are shown in Table 4-10.

User Service Charge. The user service charge is the basic continuing revenue producer other than ad valorem taxes (property taxes). The user charge can be allocated in a variety of ways providing alternative methods of equitably spreading costs to those benefiting from service. Anticipated sewer rates with the implementation of the alternatives are discussed in a subsequent section. Portions of the following are quoted from the U. S. Army Corps of Engineers (1976 Appendix F).

> "Ad Valorem Taxes. Taxes levied in proportion to the value of the property are a potential revenue source that can be used to pay for either bond amortization or recurring operation and maintenance costs. Due to the trend of commitment of taxes for other civic purposes up to the limit of the maximum statutory rate and because of the inequities inherent in the payments related to the services, this revenue source has not been favored recently for financing.
>
> "The principal classes of long-term debt instruments used to finance projects which have community-wide benefit are: (1) general obligation bonds and (2) revenue bonds. Special assessment bonds are used to finance facilities which provide immediate and localized benefits.
>
> "General Obligation Bonds are secured by the full faith and credit of the issuing agency, and the issuer is obligated to levy ad valorem (property) taxes to pay annual bond interest and principal, to the extent other funds are not available. The issuer may use revenues from service charges or other sources to meet the required payments on the bonds.
>
> "With a revenue-supported general obligation bond, revenues from the enterprise are pledged toward payment of debt service. This limits the potential increase in the general tax rate. Self-supporting general obligation bonds have the advantages of a revenue bond, but maintain the low interest rate and ready marketability of general obligation bonds secured by the taxing power of the issuing agency. Under the present statutes general obligation bonds of a constitutionally created entity (cities, counties) must receive an affirmative vote of three-fifths (60 percent) of those casting a vote on the measure to authorize the bonds."

The limits on bonds which a city may issue are based on the total property value of the community. A Washington city is authorized to issue general obligation bonds of up to 2 1/2 percent of total property value for general purposes and up to 5 percent of total property value for special

Table 4-10*

FINANCING POWERS OF AGENCIES

Agency	Power to Tax	Power to Levy Rates & Charges	Uniform Charges Required	Lien for Delinquent Charges	Other	General Indebtedness Bonds		General Indebt. - Revenue Bonds	Revenue Bonds		Refunding Bonds
						Election[1]	Limitations		Election	Limitations	
City/Town RWC 35.67	Yes	Yes	For each class	Yes	Special tax allowed 35.21.280	Always required	No interest max-30 yr. max	Yes	Required over 1.5%[1] property value	30.yr. max.	Yes
Sewer/Water District[2] RCW 56.16/ 57.08.065	Yes	Yes	For each class	Yes	Charges must meet costs[2]	Always required	No interest max-30 yr. max	None spec.	Always required (1/2 majority) to 1.5% property[3] value	30 yr. max.	Yes
Diking and Drainage Dist./No Sewer improvement Dist. RCW 85.08 & 85.16	No	Assessments	Per benefit	Yes-unpaid assessments	—	N. A.[4]	N. A.	N. A.	N. A.	N. A.	Yes

[1] An election is also required under 1.5 percent unless a health hazard exists.
[2] Water district providing sewerage services may exercise powers of a sewer district, RCW 57.08.065.
[3] Except in case of additions and betterments.
[4] Not applicable.

* Modified from U. S. Army Corps of Engineers, 1976, Appendix F

purposes. Councilmanic bonds are limited to 0.75 percent of the property value and are not subject to voter approval. Legal limitations on indebtedness and margin of indebtedness remaining for the City of Spokane are shown in Table 4-11.

> "Revenue bonds are secured solely by a pledge of the revenues from the facility or enterprise they are used to acquire, construct or improve. This type of bond may be issued to finance storm sewer improvements. Usually a simple majority vote is required. In the case of the city, revenue bonds may be issued with only governing board approval for facilities conforming to an approved general plan. The agency cannot levy taxes for the payment of revenue bond service and there is no obligation to levy taxes for the maintenance and operation of the enterprise which produces the revenues pledged to pay revenue bond services. There is no legal limitation on the amount of authorized revenue bonds which may be issued.
>
> "The principal advantage of revenue bonds is that funds for payment of the bonds are derived solely from those who use the facilities for which the bonds were issed. Revenue bonds can never become a lien or charge against real property. An additional advantage lies in the fact that approval by three-fifths of the voters is not required, as in the case of general obligation bonds. Revenue bonds are not considered applicable debt toward an entity's general obligation bonding capacity.
>
> "A disadvantage of this type of bond is that revenues to secure their payment must be from 25 to 50 percent above actual requirements to insure [ensure] their saleability. In the case of grant-aided facilities, however, this requirement may fulfill the need to obtain sufficient funds for depreciation accruals or for capital improvements, uses which also satisfy the 25 to 50 percent ocverage factor to market the bonds.
>
> "Assessment bond financing is a possible vehicle for a project of identifiable benefit. A utility local improvement district (ULID) can be established and assessments spread for projects of special local benefit. Assessments constitute a lien against the benefited property which serves as security for issuance of bonds to finance the project costs. These liens would not represent an encumbrance on any overlapping district and do not affect any district's debt capacity. The property securing the lien must, however, be of sufficient value to more than cover the assessment. Assessments must be spread only over property that benefits from the project. Assessment bonds have specific application to finance projects where the benefits of facilities can be easily identified."

Table 4-11

City of Spokane
LIMITATION OF INDEBTEDNESS
December 31, 1977

Value of Taxable Property		$1,835,660,452	
Assessed Value of Taxable Property		1,835,660,452	
I INDEBTEDNESS FOR GENERAL PURPOSES WITHOUT A VOTE OF THE PEOPLE **(Councilmanic Bonds)** LEGAL LIMIT 3/4 of 1% ON PROPERTY VALUE			$13,767,453
INDEBTEDNESS INCURRED			
G O Bond Liabilities	$4,280,000		
Less Redemption Fund Assets:			
Cash-Stadium I & R Fund	(135,646)		
Excess of Liabilities Over Assets		$4,144,354	
Park Fund-Lease/Option Agree.		4,418	
Utilities Comm. Fund Liab.-Contract		156,794	
Total Net General Indebtedness			4,305,566
Margin of Indebtedness Still Available			$ 9,461,887
II INDEBTEDNESS FOR GENERAL PURPOSES WITH A 3/5 VOTE OF THE PEOPLE **(General Obligation Bonds)** LEGAL LIMIT @ 2½% ON PROPERTY VALUE			$45,891,511
INDEBTEDNESS INCURRED			
G O Bond Liabilities	$2,267,000		
Less Redemption Fund Assets:			
Cash	(319,668)		
Excess of Liabilities Over Assets		1,947,332	
Net General Indebtedness From Section I		4,305,566	
Combined Indebtedness Section I & II			6,252,898
Margin of Indebtedness Still Available			$39,638,613
III INDEBTEDNESS FOR SPECIAL PURPOSES WITH A 3/5 VOTE OF THE PEOPLE LEGAL LIMIT @ 5% ON PROPERTY VALUE			$91,783,023
INDEBTEDNESS INCURRED	-0-		
Combined Indebtedness-Sections I, II, & III			6,252,898
Margin of Indebtedness Still Available			$85,530,125

SOURCE: City of Spokane, Washington, 1977

Water and Sewer Service Revenue/Expenditures

The city's sewer charges currently bring in about $3,300,000 annually, with expenditures estimated at $4,732,000 for fiscal year 1978 (Forten, pers. comm.). Costs of existing sewerage facilities are shown in Table 4-12. Outstanding water and sewer revenue bonds are shown in Table 4-13.

Impact of Alternatives on Property Values/Taxes

Alternative 1 - Storage Basins and Relief Sewers. Land costs for storage or treatment facilities were estimated at $65,000 per acre for the approximately 60 acres required. Assuming that this reflects the actual market value of the land to be acquired, this alternative could remove land valued at $3,890,000 from the tax rolls. The property tax rate in 1977 in the city was $18.961 per $1,000 of property value (100 percent of true and fair value), which was allocated as follows:

City of Spokane	4.606
County of Spokane and State of Washington	6.145
School District	8.210
Total	$18.961

Based on 1977 tax levies and assessed valuations, this alternative could result in an annual loss of about $73,758 in total revenue to the taxing agencies. Sales of construction materials would increase local sales tax revenue. The disruptive impact of construction on commercial activities may cause a minor decrease in sales tax revenue.

Alternative 2 - Satellite Treatment and Relief Sewers. An estimated 9.7 acres of land would be required for this alternative. Based on the land values and tax levies previously described, this alternative would result in removal of land valued at $628,050 from the tax rolls. The tax revenue decrease would, therefore, be $11,908 annually. Impacts on sales tax revenue would be comparable to Alternative 1.

Alternative 3 - Separate Storm Sewers. According to the Spokane County Assessors Office, sewer backup problems have not been sufficiently severe to reduce property values (McBride, pers. comm.). Therefore, a complete solution to the problem may not have a measurable effect on property values. This alternative would not require removal of any

Table 4-12

SUMMARY, HISTORICAL COST OF EXISTING SEWERAGE FACILITIES

Entity	Description	Estimated Major Facilities Investment[1]	Total Grants
City of Spokane			
Treatment Plant	40 mgd primary treatment	$ 628,000	$ 171,000
Interceptors	24 inches to 72 inches	1,030,000	--
Pump Stations	numerous	127,000	--
Improvements in Progress	secondary treatment plant	45,800,000	41,101,000 (completed 1978)

[1] Based on entity records

Table 4-13

WATER-SEWER REVENUE BONDS SCHEDULE OF REQUIREMENTS PRINCIPAL AND INTEREST
December 31, 1977[1]

Year	Outstanding Beginning of Year	Principal	Interest	Total Requirements
1978	$218,000.00	$ 69,000.00	$ 6,422.50	$ 75,422.50
1979	149,000.00	73,000.00	3,937.50	76,937.50
1980	76,000.00	76,000.00	1,330.00	77,330.00
		$218,000.00	$11,690.00	$229,690.00

SOURCE: City of Spokane, Washington, 1977 property from municipal tax rolls. Should the alternative indirectly result in additional areas being sewered within the city, there may be a beneficial impact on property values and revenues. Land values are typically $1,500 higher for sewered lots in comparison to unsewered lots (McBride, pers. comm.). Increased sales of construction materials would have a short-term beneficial impact on sales tax revenue. Conversely, loss of sales due to short-term disruption of commercial activities would reduce sales tax revenues to the city.

Klicker Storage Suboption. This alternative would remove an estimated 68.5 acres of land valued at $65,000 from municipal and county tax rolls. Based on tax levies previously described, the tax revenue loss is estimated at about $84,424 annually. To the extent that surface storage basins reduce the desirability and value of affected residential areas, there may be a minor long-term decrease in property tax revenue. Beneficial and adverse impacts on sales tax revenue would be of the same type described in Alternative 1.

Latenser Plan. This plan would have the greatest land requirements of the alternatives analyzed. Approximately 101 acres of land would potentially be removed from municipal and county tax rolls. Based on land values and tax levies previously discussed, the tax revenue loss is estimated at a maximum of $124,849 annually. It should be noted that the land costs of $65,000 per acre used in estimating project costs would appear high for the extensive rural lands required for this alternative, and therefore, estimates of property tax loss are probably high. The irrigation benefits provided by this alternative could significantly increase the value of receiving agricultural lands in Lincoln County. Beneficial and adverse impacts on sales tax revenue would be of the same type described in Alternative 1.

Combination Concept. An estimated 16 acres of land would be required for this alternative. Based on land values and tax levies previously described, this alternative would remove land valued at $1,040,000 from municipal and county tax rolls with a resulting revenue decrease of approximately $19,720 to taxing agencies. Sales of construction materials would increase local sales tax revenue. This would be offset to a degree by loss of sales tax revenue due to disruption of commercial zones during construction.

No-Action. As property values have not been appreciably affected by existing backup problems, this alternative would have no significant impact on existing values. However, to the extent that city policy and private development restraints dictate nondevelopment of areas suffering from severe backup problems, there would be a long-term reduction in future property values of backup areas.

Impact of the Alternatives on The Spokane Area Economy

User Charge Increases

Actual user charge increases attributable to the various alternatives cannot be determined until the level of grant funding and methods of financing are established. However, as discussed under Changes in Sewer User Rates, tentative estimates based on two potential methods of financing have been computed for all of the structural alternatives. The estimated values are computed examples to enable a comparison of the alternatives. Actual rates may differ significantly from these estimates.

An increase in rates may result with implementation of any of the alternatives. All residential dwellings, including multiple family and mobile home units, are currently charged a flat rate of $3.20 per month for sewer service. Commercial and industrial establishments are charged on the basis of flow, with a minimum charge also in effect. The schedule of charges is on Table 4-14.

An additional charge is imposed if maximum allowable standard wastes discharged into the sewerage system are exceeded. Special sewer rates are granted to churches and certain public or charitable institutions. A 6 percent tax is levied on the combined water-sewer-refuse billing for all users.

Flat Rate Increase. One method of financing the city's share of the project would be a flat rate increase for all users. The increase would most seriously affect residential users, particularly the relatively large percentage of low income and elderly persons on fixed incomes who reside within the city. The added cost would generally represent a proportionately lower increase in fixed costs for commercial and industrial establishments within the city. Table 4-15. summarizes the estimated increases for residential users.

Ad Valorem Tax Increase. Increased ad valorem (property) taxes are another method of financing the selected alternative. Although the increased tax rate would be applied equally to all development in the city, the cost burden would tend to be disproportionately higher for commercial and industrial development due to their higher assessed valuation. The costs would be most inequitable for large scale industrial and commercial development. For example, a business concern valued at $10 million would pay increased property taxes of from $24,000 to $25,000 annually for implementation of any but the Latenser alternative. It is not known whether this additional charge would be sufficient to discourage location

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Table 4-14

SEWER SERVICE CHARGES - INDUSTRIAL USERS

Amount	The Charge Shall Be
From 0 to 100,000 cubic feet	$ .160 per 100 cubic feet
From 100,000 to 250,000 cubic feet	.138 per 100 cubic feet
From 250,000 to 500,000 cubic feet	.117 per 100 cubic feet
From 500,000 and up cubic feet	.085 per 100 cubic feet

In no case shall the charge be less than the minimum tabulated in the chart below:

Size of Service Based on Size of Domestic Water Meter	Minimum Charge Per Month
all services below 1 1/2 inches	$ 4.25
1 1/2 inches	7.70
2 inches	10.65
3 inches	16.60
4 inches	23.35
6 inches	31.95
8 inches	63.95

Table 4-15

ANNUAL IMPACT ON SEWER USER RATES IF USER CHARGES USED TO FINANCE LOCAL SHARE OF PROJECT COSTS

Alternative	Current User[1] Charge (Residential) Dollars	Estimated Increase[2] Dollars	Percent Increase	Total and Annual Charge Anticipated[1] Dollars
#1 - Storage Basins and Relief Sewers	38.40	94.10	145	132.50
#2 - Satellite Treatment and Relief Sewers	38.40	87.49	127	125.89
#3 - Separate Storm Sewers	38.40	32.59	85	70.99
#4 - Klicker Storage Suboption	38.40	30.38	79	68.78
#5 - Latenser Export Plan	38.40	162.73	423	201.13
#6 - Combination Concept	38.40	77.09	50	115.49
#7 - No-Action	38.40	Not Known	-	38.40

[1] Does not include 6 percent tax levy or combined water-sewer refuse billing.
[2] Based on 56,000 sewer connections.

of new business in metropolitan Spokane, or result in relocation of business and industry to areas outside the city. However, it should be noted that sewage service costs in outlying, unincorporated areas may soon increase as many county areas are now considering construction of sewer systems of their own. This is true of North Spokane and Liberty Lake; Spokane Valley may also soon embark on a facilities planning effort. Therefore, relocation of businesses or industries simply on the basis of increased taxes for sewage facilities does not seem likely unless the increases are extremely large. Tables 4-16 and 4-17 show typical increases in property taxes which could be anticipated for residential, commercial, and industrial development with the various alternatives.

Table 4-16

IMPACT ON TAX RATES IN RESIDENTIAL AREAS IF AD VALOREM TAX USED TO FINANCE LOCAL SHARE OF PROJECT COSTS

Alternative	Number Residential Units[1]	Average Value Per Unit[2]	Current Tax Rate[3]	Estimated Tax Increase[5]	Percent Increase[4]	Without Project Tax Per Average Residential Unit	With Project Tax Per Residential Unit	Annual Dollar Increase In Tax Levy Per Unit
#1 - Storage Basins and Relief Sewers	71,244	$35,000	18.961	$2.87	15	$664	$764	$100.00
#2 - Satellite Treatment and Relief Sewers	71,244	35,000	18.961	2.66	14	664	757	93.00
#3 - Separate Storm Sewers	71,244	35,000	18.961	0.99	5	664	698	34.00
#4 - Klicker Storage Sub-option	71,244	35,000	18.961	0.93	5	664	696	32.00
#5 - Latenser Export Plan	71,244	35,000	18.961	4.96	26	664	837	173.00
#6 - Combination Concept	71,244	35,000	18.961	2.35	12	664	746	82.00
#7 - No-Action	71,244	35,000	18.961	-	-	664		

[1] Includes all single family, duplex, multi-family, and mobile home units in City of Spokane (Spokane Area Development Council, 1978).

[2] Spokane Area Development Council, 1978.

[3] Per $1,000 of assessed (fair market) value.

[4] All figures rounded.

[5] All increases calculated assuming a total city assessed valuation of $1,835,660,452.

Table 4-17

IMPACT OF INCREASED AD VALOREM TAX ON COMMERCIAL AND INDUSTRIAL DEVELOPMENT (CITY OF SPOKANE)

Alternative	Average Value Per Unit[1]	Current Tax Rate	Estimated Tax Increase	Percent[2] Increase	Without Project Tax Average Commercial Unit	With Project Tax Average Commercial Unit	Annual Dollar Increase In Tax Levy By Commercial Unit
#1 - Storage Basin and Relief Sewers	$192,000	$18.961	2.87	15	$3,641	$4,192	$551.00
#2 - Satellite Treatment and Relief Sewers	192,000	18.961	2.66	14	3,641	4,151	510.00
#3 - Separate Storm Sewers	192,000	18.961	0.99	5	3,641	3,831	190.00
#4 - Klicker Storage Sub-Option	192,000	18.961	0.93	5	3,641	3,819	178.00
#5 - Latenser Export Plan	192,000	18.961	4.96	26	3,641	4,593	952.00
#6 - Combination Concept	192,000	18.961	2.35	12	3,641	4,092	451.00
#7 - No-Action	192,000	18.961	-	-	3,641	3,641	-

[1] Based on average value for all new commercial and industrial building permits issued in City of Spokane in 1977.

[2] All figures rounded.

Energy and Resource Consumption of Alternatives

Energy

The Spokane wastewater treatment system presently includes a large advance waste treatment plant (40 mgd design capacity) and 19 separate pump stations in the wastewater collection network. Based on an analysis of plant records for the first six months of 1978, the treatment plant consumed an average of about 1,770,000 kilowatt hours (Kwh) of electricity per month, or roughly 1,562 Kwh per million gallons treated.

Project Alternative 1 would increase electrical consumption primarily at the treatment plant, as approximately 547 million gallons per year of additional flow would be fed from the storage basins through the treatment system. At the plant's existing unit consumption rate, this would increase annual energy use by about 854,000 Kwh for an annual cost increase of $8,967. Alternative 2 would not significantly change energy use at the plant, but there would be some electricla energy demand at the satellite treatment sites. The CSO Facilities Plan (Spokane City Department of Public Works, 1977) did not estimate the power requirements for this extra treatment, but the volume that would be treated would be the same as for Alternative 1. However, the treatment would be primary rather than secondary. Alternative 3 would significantly reduce the energy requirements for collection and treatment because the volume of water reaching the plant would be greatly reduced. Assuming separate storm sewers cut flows into the plant from the 39 mgd averaged over the first six months of 1978 to about 28 mgd (the estimated average dry weather flow based on September-October 1977 records), the annual energy savings at the plant would be about 6,270,000 Kwh (a $65,835 annual cost savings at current electricity rates).

The Klicker and Latenser storage options would both require more energy than the existing system. Klicker's plan would increase flows into the treatment plant at roughly the same rate as Alternative 1, increasing energy consumption similarly. The planned use of Bridge Street surface storage would add a small increment to the collection system energy consumption because water from this site would have to be pumped northward back into the system rather than flow by gravity into the basin as planned in Alternative 1. Latenser's plan would increase energy requirements tremendously. Pumping at the Erie Street and Clarke Street pump stations would be significantly increased and flows into the treatment plant would increase almost as much as Alternative 1. Energy consumed during tertiary treatment would no longer be needed, but all wastewater would be pumped up out of the Spokane River basin after treatment. This would be a vertical lift of over 700 feet. Pumping would also be required to lift water out of Crab Creek and carry it to surrounding agricultural land.

The No-Action Alternative would leave energy consumption at its present rate.

The most effective means of keeping energy consumption to a minimum and still effect some level of CSO control would be to select Alternative 3. It would require much less energy in wastewater treatment than any of the other project alternatives. If a storage alternative is eventually selected for implementation, efforts should be made to keep pumping back from the storage basins to a minimum. If gravity feedback is feasible, it should be utilized. If satellite treatment is selected for use, energy efficiency should be a major criterion in selecting the type of treatment unit to be installed.

Chemicals

In the first six months of 1978, the Spokane wastewater treatment plant treated an average of 39 million gallons of water per day. In order to treat and disinfect the wastewater, varying amounts of ferric chloride, quicklime, alum and chlorine were utilized. Table 4-18 below summarizes the average rate of chemical consumption over this February to June 1978 period.

Table 4-18

EXISTING CHEMICAL CONSUMPTION AT THE SPOKANE STP FEBRUARY - JUNE 1978*

	Average Rate of Consumption	
Chemical	LB/Month	LB/MG Treated
Chlorine	17,910	15.8
Ferric Chloride	134,730	118.4
Quicklime	445,673	396.0
Alum (Liquid Form)	637,287	556.7

*SOURCE: Compiled from wastewater treatment plant records.

The CSO abatement alternatives would change this chemical consumption pattern in varying degrees. Alternative 1 and the Klicker storage option would require minor increases in the annual volume of chemicals used because flows through the plant would increase. If all of the estimated annual combined sewer overflow (547 million gallons) was stored and eventually passed through the plant, ferric chloride use would increase by as much as 64,800 pounds per year. Quicklime use would increase by 217,000 pounds, alum use would increase by 305,000 pounds and chlorine use would increase by 8,600 pounds (total annual cost of $25,800 at current rates of charge). Alternative 2 would require similar increases, but the polymer and chlorine consumption would occur during primary treatment of overflow at satellite plants rather than from phosphorus removal at the main plant site. Alternative 3 would cut chemical use because flows into the plant would be reduced by nearly one-third on an average daily flow basis. Ferric chloride use would be reduced by as much as 475,000 pounds per year, quicklime use by 1,600,000 pounds per year, alum use by 2,235,000 pounds per year and chlorine use by 63,000 pounds per year. At present chemical costs, this would create an annual operations savings of about $132,600.

The Latenser Plan would eliminate a major element of chemical use because phosphorus removal would no longer be necessary. Chlorination and sludge treatment would still be required, but alum and ferric chloride use could be discontinued. The increase in chlorine and quicklime use would be similar to Alternative 1 due to the increase in flows through the plant. The net decrease in annual chemical costs would be over $452,000 with the Latenser Plan.

The No-Action option would not alter chemical use patterns at the Spokane treatment plant site. Chemical consumption at the Spokane plant could best be kept to a minimum by adopting the Latenser Plan, which eliminates the need for phosphorus removal. However, this alternative has extremely large energy requirements. If discharge to the Spokane River is maintained as the disposal mode, adoption of Alternative 3 would do the most for reducing chemical use. The only other means of significantly reducing chemical consumption would be to alter or eliminate the plant's NPDES permit phosphorus removal requirement.

Influence of CSO Alternatives on the Spokane Wastewater Treatment Plant Capacity and Long-Term Viability

The new Spokane wastewater treatment plant was designed to treat an average dry weather flow of 40 mgd. This was considered sufficient to accommodate flows from the city until the turn of the century (Bovay Engineers, Inc., 1977). Under wet weather conditions, the interceptor leading into the treatment plant can carry a peak flow of 146 mgd. Under these short-term peak flow conditions, the existing secondary treatment facilities can treat a peak hourly flow equivalent of 77 mgd. All flows beyond 77 mgd are diverted into the plant's two stormwater primary clarifiers. These units give primary treatment to the remaining 69 mgd. The treatment does not meet DOE wastewater discharge requirements.

The plant was designed to be easily expanded to a 60 mgd average dry weather flow capacity by converting the two stormwater primary clarifiers to secondary clarifiers. This would extend the plant's effective life to about 2025 and allow it to accommodate flows from areas outside the city (Bovay Engineers, Inc., Text). In order to change the stormwater clarifiers to secondary clarifiers, however, stormwater flows must be removed for the city's sanitary sewer system. It should also be mentioned that this expansion of secondary treatment capacity would eliminate the emergency capacity the plant now has with its infrequently used stormwater clarifiers.

In 1972 the city's average dry weather flows were estimated to be 27.3 mgd. Between January and June 1978 flows into the plant have averaged 39 mgd (based on city treatment plant records). Of this total, about 28 mgd is believed to be domestic and industrial sewage (equivalent to average dry weather flow for design purposes) and the rest is stormwater (based on September-October 1977 plant inflow records).

The CSO abatement alternatives have differing effects on the treatment plant's hydraulic loadings. Alternative 1 proposes storage of stormwater which under present conditions overflows into the river. The storage would not significantly change the plant's hydraulic loading during peak wet weather conditions; it would, however, extend the period of high flows into the plant well after a storm had ceased. The treatment plant would be treating a larger volume of water on an annual basis, but its effective life to serve the city would not be altered. The plant's primary stormwater clarifiers would still be needed to treat peak flows; they would not be modified to secondary clarifiers for an increase in advanced treatment capability.

The Klicker storage suboption would have a similar effect on the plant's hydraulics and effective lifetime. However, it would catch a greater volume of the current annual overflow when compared to the city's storage option (Alternative 1). This would result in a prolonged peak inflow to the plant after a storm. The city's storage option would allow overflows from the 25-year frequency storm, while Klicker storage would essentially catch all overflows.

In order for the Klicker plan to accept flow from county areas, the Bridge Street storage reservoir would have to be oversized to store all wet weather flows coming in from outlying areas annexed to the city system. The extra storage would relieve any additional hydraulic loading on the treatment plant during storms. Hook-ups from outlying areas would have to be made to the North Bluff interceptor, as this is the line tapped by Bridge Street storage. However, only through complete sewer separation can the plant's two stormwater clarifiers be converted to secondary clarifier use. Without this modification, the plant cannot be upgraded to a full 60 mgd ADWF capacity for its secondary treatment processes and truly become a regional facility.

The Latenser storage and export option is quite similar to the Klicker Plan in its effect on plant hydraulics and long-term viability. Hydraulic overloading in the upper portions of the collection system is relieved by a combination of rerouting flows and putting in some separate storm sewers. Excess flows reaching the Meenach Drive overflow point are diverted through a new interceptor to storage across the river from the treatment plant site. If this diversion and storage were sized to accommodate flows for newly annexed county areas in addition to the city's excess wet weather flows, some county wastewater could be accepted at the Spokane plant. The volume of added flow the city could accept would depend upon the sizing of this storage basin. However, the plans as proposed by Mr. Latenser did not include sizing for connection of county areas.

The city's Alternative 2 proposes primary treatment of CSO at satellite treatment plants rather than either storage or stormwater separation. This would have no effect on the treatment plant's capacity, now or in the future. The wastewater system would function just as it does now except overflows to the river would receive an equivalent of primary treatment prior to discharge.

Alternative 3 could have a major impact on the treatment plant's capacity. First, it would remove all of the stormwater flows fed to the plant during rainstorms or snowmelt. Only sanitary wastewater and infiltration/inflow would reach the plant. With an existing average dry weather flow (ADWF) of 28 mgd coming from the city and a design capacity of 40 mgd ADWF, there would be 12 mgd of unused capacity in the plant. The CSO abatement facilities plan (Spokane City Department of Public Works, 1977, Supplement) indicated that the city's sewered population would increase to about 189,282 by the year 2000, with an average dry weather wastewater flow of 34.25 mgd (assuming sewer separation). This included the addition of Moran Prairie and Southwest, two planning areas currently outside the city's sewer service area (see Table 4-19 and Figure 4-8). By 2020 the population and flows were expected to increase to 204,315 and 36.86 ADWF, respectively. These population and flow estimates are lower than those reported in the Spokane treatment plant facilities plan (Bovay Engineers, Inc., 1973), but are identical to those presented in the Metropolitan Spokane study (U. S. Department of Army, Corps of Engineers, 1976, Technical Report). The projections indicate that if all stormwater is removed from the city's sanitary sewer system as planned in Alternative 3, there would be sufficient capacity in the plant to accept a sizeable county wastewater flow with little or no plant modification. If the two clarifiers now used for primary treatment of stormwater were converted to secondary clarifiers (along with other minor plant modifications), the plant's average dry weather capacity would increase to about 60 mgd. Therefore, there would be over 23 mgd of available plant capacity through the year 2020 if all stormwater flows were removed from the sanitary sewer system. This assumes, however, that the phosphorus removal units of the treatment system need no modification to accommodate a 60 mgd ADWF. Draft information prepared by Kennedy Engineers, Inc., (1978a) for an amendment to the North Spokane facilities plan suggests that the phosphorus removal units cannot properly treat flows beyond 57 mgd without expansion. Reference to population and flow estimates for the year 2020 have been included only to show the relationship of the alternative to earlier long-range planning conducted for the city and county. Projections that far in the future are generally speculative and are not used for EPA planning purposes. The projections for the 1980 to 2000 planning period are the primary basis for state and EPA participation in local facilities planning.

Table 4-19 lists projected populations and wastewater flows for the three county areas that might be served by the Spokane wastewater plant if Alternative 3 were implemented. Table 4-20 shows combined wastewater flows under various schemes of hooking these county areas to the city treatment system. A brief discussion of these regionalization possibilities is presented in the following paragraphs.

Table 4-19

POPULATION AND FLOW ESTIMATES - METROPOLITAN SPOKANE WASTEWATER SERVICE AREAS

Service Area	1990		2000		2020[7]	
City of Spokane[1]						
Population served	182,506		189,282		204,315	
Flows (ADWF)[2]	32.39		34.25		36.86	
North Spokane[3]						
Population served	29,433		44,627		62,482	
Flows (ADWF)	3.91		5.80		7.96	
Spokane Valley[4]						
Population served	117,630	(104,930)	148,990	(131,360)	217,080	(184,820)
Flows (ADWF)	11.52	(10.27)	16.15	(14.38)	23.40	(20.18)
Spokane Plains (W. Plateau)[5]						
Population served	2,187		2,614		3,532	
Flows (ADWF)			3.7[6]			

[1] 1990 and 2020 data from U. S. Department of Army, Corps of Engineers, 1976, Technical Report, year 2000 data from City of Spokane Department of Public Works, 1977, Supplement; estimates include Moran Prairie and southwest, assuming sewer separation.

[2] ADWF is average dry weather flow, including residential, commercial, industrial and infiltration components.

[3] Data from U. S. Department of Army, Corps of Engineers, 1976, Tecnical Report and used in Kennedy Engineers, Inc., 1978

[4] Data from URS Company, 1978; population and flow numbers in parentheses do not include planning areas SV-7 and SV-8, the Newman and Liberty Lake areas.

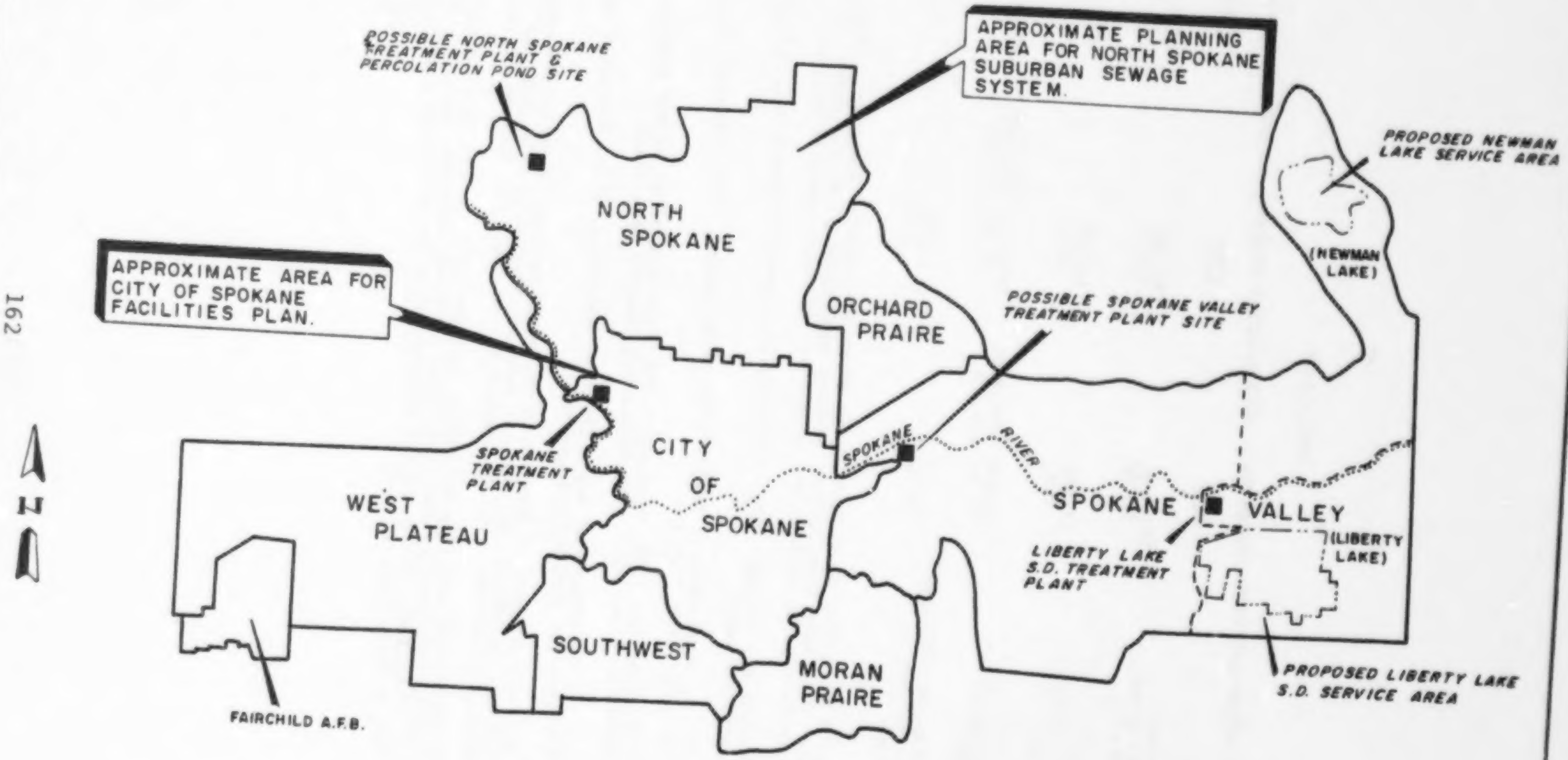
[5] Data from U. S. Department of Army, Corps of Engineers, 1976, Technical Report; assumes Spokane Plains water supply is augmented.

[6] Flow is not proportional to population estimates because Corps Report added flows from Airway Heights, Fairchild AFB, Medical Lake and Cheney to this planning area without adding their populations. No flow figure is available for Spokane Plains only.

[7] Year 2020 population and flow estimates included only to show relationship between current facilities planning and long-range planning conducted earlier for the City and County of Spokane; state and EPA participation in facilities planning is limited to the 1980 to 2000 planning period.

FIGURE 4-8

METROPOLITAN SPOKANE PLANNING UNITS* & WASTEWATER TREATMENT FACILITIES


POSSIBLE NORTH SPOKANE TREATMENT PLANT & PERCOLATION POND SITE
APPROXIMATE PLANNING AREA FOR NORTH SPOKANE SUBURBAN SEWAGE SYSTEM.
PROPOSED NEWMAN LAKE SERVICE AREA
(NEWMAN LAKE)
NORTH SPOKANE
APPROXIMATE AREA FOR CITY OF SPOKANE FACILITIES PLAN.
ORCHARD PRAIRE
POSSIBLE SPOKANE VALLEY TREATMENT PLANT SITE
SPOKANE RIVER
CITY OF SPOKANE
SPOKANE TREATMENT PLANT
WEST PLATEAU
SPOKANE VALLEY
(LIBERTY LAKE)
LIBERTY LAKE S.D. TREATMENT PLANT
SOUTHWEST
MORAN PRAIRE
PROPOSED LIBERTY LAKE S.D. SERVICE AREA
FAIRCHILD A.F.B.
N

* PLANNING UNITS USED BY U.S. DEPARTMENT OF ARMY, CORPS OF ENGINEERS(1976) & SPOKANE METROPOLITAN AREA TRANSPORTATION STUDY.

SOURCE: MODIFIED FROM U.S. ARMY CORPS OF ENGINEERS, 1976, TECHNICAL REPORT

Table 4-20[1]

FLOWS TO THE SPOKANE TREATMENT PLANT UNDER VARIOUS REGIONALIZATION SCHEMES

Regionalization Schemes	Wastewater Flows (ADWF)		
	1990	2000	2020
City of Spokane and North Spokane	36.3	40.05	44.72
City of Spokane and Spokane Valley[2]	43.91	50.4	60.26
City of Spokane and Spokane Plains		37.95	
City of Spokane and North Spokane and Spokane Valley[2]	47.82	56.2	68.22
City of Spokane and North Spokane, Spokane Valley and Spokane Plains[2]		59.9	

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[1] Computed from data presented in Table 4-19.

[2] Spokane Valley total includes Liberty Lake and Newman Lake.

As Table 4-20 indicates, the Spokane plant could treat the projected City and North Spokane flows to beyond the year 2020 if complete sewer separation occurs and the plant is expanded to a 60 mgd capacity. Even without the capacity increase, the existing plant could accommodate the combined flows until the year 2000. This assumes the plant phosphorus removal units are capable of treating the increased flows (see earlier note about possible phosphorus unit limitations). This regionalization scheme has recently been studied by Kennedy Engineers Inc., (1978a). Their rough draft report suggests there is adequate trunk sewer capacity in the city system at Rowan and Milton to accommodate North Spokane flows until about 1990. After that date, a paralleling relief sewer to the city main interceptor would be needed. It is important to note that the actual timing of transferring North Spokane wastewater to the city treatment plant would be dependent upon completion of total sewer separation in the city (perhaps 10 years for construction) and sewering of the North Spokane area.

If Spokane Valley wastewater is to be treated at the Spokane plant, the life expectancy of the treatment system would be much shorter. Based on the projections shown in Table 4-19 the combined city and valley flows would exceed the ultimate plant capacity of 60 mgd before the year 2020. This assumes that the entire valley population would be sewered by then; however, it also includes flows from both Liberty Lake and Newman Lake. If the Liberty and Newman Lake systems remain separated from the rest of the valley and if complete sewering of the valley planning area does not occur, the Spokane plant's life expectancy would be extended beyond 2020 under this regionalization scheme. A brief analysis of valley regionalization prepared by URS Company (1978) as part of the county 208 plan program indicates that there are two possible locations to tap valley flows into the city interceptor system. The northern part of the valley interceptor system could connect to the city at Mallon Avenue and Perry Street (42" diameter pipe), and the southern part could connect at Harston Avenue and Havana Street. As noted in discussing North Spokane regionalization possibilities, the actual timing of hooking the valley into the city wastewater treatment system would be dependent upon completion of the city sewer separation project and sewering of the valley populations.

If both North Spokane and Spokane Valley (including Liberty and Newman Lakes) were to be tied to the city treatment system, the Spokane plant's expanded 60 mgd capacity would be able to accommodate projected flows (Table 4-20) until about 2005 or 2010. The combined flows would theoretically be about 56.2 mgd by the year 2000. Again, the actual timing of reaching the 60 mgd capacity would be dependent on the rate at which the county populations were sewered and connected to the city interceptor system.

The combination CSO control concept, which includes some storage and some separate sewers, would eliminate storm flows from 8 of the 14 drainage groupings in the city (See Figure 2-7). This would reduce peak flows into the plant, but would not be sufficient to completely abandon the primary stormwater clarifiers. Therefore, some outside flows could be fed into the plant, but they might not receive full AWT treatment and eventual plant expansion to 60 mgd could not be realized. The 8 areas that would receive separate sewers contribute about 24 percent of the theoretical maximum stormwater inflow to the city's main interceptor.

A no-action alternative would perpetuate the Spokane plant's present hydraulic overloading situation and would not allow for any regional tie-ins to the city system. Anticipated flow increases from growth within the city service area would simply add to the volume of combined sewer overflows or bypassing through the plant's storm water treatment system.

The concept of using the Spokane treatment plant as a regional wastewater facility is scheduled to receive more detailed analysis as part of a comprehensive county 201 facilities plan the Spokane County Engineers are hoping to initiate in the near future.

Environmental Considerations for Regionalization of Wastewater Treatment

The previous section dealt with the various CSO alternatives and their influence on the Spokane treatment plant's ability to provide wastewater treatment to outlying county areas. This is an important topic because wastewater facilities planning is proceeding at a rapid rate for many of the unsewered areas surrounding Spokane. Preliminary draft facilities plans have recently been prepared for North Spokane and the Liberty Lake Sanitation District, and a draft facilities plan has been published for the Newman Lake area. It is essential that the environmental pros and cons of regionalizing wastewater treatment be considered prior to making long-term decisions for the county areas on an individual basis. There is currently no single planning effort underway with a broad enough scope to consider all of the ramifications of regionalization as compared to local wastewater treatment and disposal. However, Spokane County is now seeking federal and state grant funds to prepare a single facilities plan for the entire unincorporated portion of metropolitan Spokane. This may bring together sufficient data to thoroughly analyze the pros and cons of wastewater regionalization in the Spokane area. The following paragraphs briefly discuss the major areas of environmental concern raised by the regionalization concept.

Rapid population growth in unincorporated urban areas surrounding Spokane has been a primary stimulus to the wastewater facilities planning now being conducted. This growth is resulting in a proliferation of individual on-site waste disposal systems and small community treatment plants. It is extremely difficult to monitor and assess the effectiveness of all of these systems and is therefore a point of concern to those federal, state and local agencies responsible for enforcing sanitation, public health and water quality standards. The dominant concern in the Spokane area is the impact of wastewater treatment and disposal on the area's groundwater. The Spokane Valley aquifer has been classified as the sole source of water supply to metropolitan Spokane and there are concerns that seepage from individual wastewater systems is contaminating this supply. A 208 planning effort by Spokane County is currently studying aquifer water quality. Two of the major tasks of that study are to determine changes in groundwater quality as it passes through the Spokane area and to investigate how man's activity is affecting the quality. The 208 plan is also reviewing and updating facilities planning data for Spokane Valley that was prepared for the U. S. Army Corps of Engineers (1976) Metropolitan Spokane study. This 208 information will be very valuable to those planning the long-range wastewater facilities needs of the Spokane Valley.

If county areas are to be sewered, there are two basic directions that can be taken. New wastewater treatment plants could be built in each of the county's urban subregions (e.g., North Spokane, Spokane Valley, Spokane Plains, etc.) or some of the outlying county areas could be tied into the Spokane city treatment plant (regionalization). The latter could more readily occur if the city's CSO problem is solved by constructing separate storm sewers. This would free up the most treatment plant and interceptor capacity.

The benefits of regionalization can be as much financial and administrative as they are environmental. Quite often there is some economy of scale attributable to a single large facility when compared to several smaller facilities. Personnel, chemical and energy costs are usually lower per volume of treated wastewater for a single facility. Administration and monitoring of treatment is also usually easier and cheaper for a single facility. In the Spokane area, regionalization could eliminate the need for one or two new wastewater treatment plants. This could be a considerable cost savings, but specific economic comparisons have not yet been made between regionalization and separate systems.

Regionalization for North Spokane means the difference between constructing an interceptor to tie into the city interceptor system or constructing a new secondary treatment plant with disposal by percolation near the junction of Rutter Parkway and Indian Trail Road (Figure 4-8). The direct construction impact of tying into the city system would be negligible. Construction of the new treatment plant at the proposed Rutter site would remove open space and farmland in an area that is expected to remain rural. Under a regionalization scheme, North Spokane's wastewater would be transported to the Spokane treatment plant for secondary treatment, phosphorus removal and discharge to the Spokane River. The hazardous chemicals, pathogenic organisms and nutrients found in that wastewater would no longer be disposed of through individual septic tanks or small community land disposal systems; they would be removed at the Spokane plant except for the small residual that would be discharged to the Spokane River. If North Spokane's wastes are collected for treatment and percolation at a new plant north of town near the Little Spokane River, the residual elements in the plant effluent would pass through the soil column before entering ground or surface waters. Kennedy Engineers, Inc. (1978) indicate that groundwater in this area is of limited quantity and use. Some of the percolate would eventually surface and possibly enter the Little Spokane River, but the filtering effect of the soil would remove most undesirable constituents. Kennedy Engineers (1978) draft amendment to the North Spokane facilities plan suggests that hooking into the city's wastewater conveyance and treatment system is the most cost-effective alternative for the North Spokane urbanized area.

The Spokane Valley has several options for treating and disposing of its wastewater. Use of the city's treatment facilities would mean that only an interceptor network would have to be constructed in the valley. This system would have to be attached to city interceptors with sufficient capacity to accommodate projected valley wastewater flows. Two potential connection locations have been identified by URS company (1978; see preceding impact discussion). Eventually, structures now using septic tanks and new developments would be sewered and wastes now entering the ground would be treated at the city plant and discharged to the Spokane River. This would mean that an additional nutrient load would be entering the river below Spokane, but it would eventually eliminate public health threats posed by septic tank wastes leaching into the Spokane-Rathdrum aquifer. If individual treatment systems are allowed to continue as the wastewater treatment mode in the valley area, there will continue to be serious, long-term threats to the health of persons relying on underground sources for their domestic water supply. This includes most of the people in the metropolitan Spokane area.

Another option for Spokane Valley is to construct new wastewater treatment facilities and develop a wastewater system independent of the city. This approach was recommended in the Metropolitan Spokane water resources study (U. S. Department of Army, Corps of Engineers, 1976). There are two suboptions to this plan: 1) construct a single facility for the entire valley near Felts Field with secondary treatment, phosphorus removal and discharge to the Spokane River; or 2) expand the Liberty Lake plant for secondary treatment of Liberty Lake and Newman Lake wastewater, with phosphorus removal and discharge to the Spokane River at Harvard Road, and treat the remainder of the valley's wastewater at the new Felts Field site as planned in suboption 1. The new Felts Field plant would be located in an urbanized area while the Liberty Lake plant expansion would remove prime agricultural land from use (U. S. Department of Agriculture, Soil Conservation Service, 1978). The Liberty Lake plant expansion is already being considered as part of a separate 201 facilities planning effort. Both of these suboptions allow for eventual elimination of individual on-site disposal systems in the valley and are therefore a long-term benefit to the water quality of the Spokane-Rathdrum aquifer. However, both of these options add an additional nutrient load to the Spokane River above the City of Spokane. All of the pros and cons of this additional discharge cannot be analyzed under the scope of this EIS, but there would undoubtedly be some change in the character of river flows through the City of Spokane. The regionalization scheme (hooking to the city system) would eliminate new upstream discharges in favor of a larger discharge from the existing city treatment plant.

It appears that the population of the metropolitan Spokane area will continue to grow quite rapidly whether or not outlying areas are connected to the city wastewater treatment system. Planning is underway to develop separate wastewater systems in many county areas and each will undoubtedly be capable of supporting expected population increases. Meanwhile, the county continues to allow development with individual unit sewage systems. Therefore, sewer service is not presently a severe constraint to development and is not expected to be in the future. New sewage collection and disposal facilities may simply accelerate the rate at which new development occurs in the presently unsewered portions of the metropolitan Spokane area.

The metropolitan Spokane water resources study projected that the entire area would grow from 292,000 in 1980 to about 353,000 in the year 2000 (U. S. Department of Army, Corps of Engineers, 1976, Technical Report). Recent recalculations of growth for Spokane Valley indicate the population is increasing even faster than this predicted rate (URS Company, 1978). The growth itself will have a separate, but significant impact on the quality of the environment in the Spokane area. Air quality, water quality, land conversion and circulation are just some of the factors strongly influenced by rapid growth. The implications of growth should therefore be carefully considered in future facility planning efforts.

Air quality and water quality problems have already developed in the Spokane area due to the large numbers of people. Carbon monoxide levels along major roadways exceed national standards on a regular basis. While planning is underway to develop mitigative measures, rapid population increases in areas such as Liberty Lake, East Farms and Mead will stimulate more traffic in and around Spokane. The air quality nonattainment plan being developed for Spokane must compensate for the population increases in order to comply with the mandates of the federal Clean Air Act. The principal water quality problems associated with growth are gradual contamination of the Spokane-Rathdrum aquifer from on-site wastewater disposal and surface water contamination from waste discharges and urban runoff. The impact of waste discharges is being considered in the Spokane CSO abatement facilities plan and other area 201 facilities plans. The problems associated with urban runoff (oils, grease, suspended solids, heavy metals, complex organics, etc.) are typically addressed in 208 planning similar to that being conducted by Spokane County. Continued urbanization means more paved surfaces, more local use of pesticides and fertilizers and more uncontrolled runoff to the Spokane River.

Another casualty of rapid growth in the Spokane area is prime agricultural land. Much of the undeveloped land around Liberty Lake, East Farms and Otis Orchards is mapped as prime agricultural land by the U. S. Department of Agriculture, Soil Conservation Service (1978). Growth in these areas will undoubtedly remove prime soils from future cultivation. Loss of prime agricultural land to urbanization is generally considered an irretrievable loss; when less productive soils are forced into cultivation as a result of the loss, both economic and energy efficiency are sacrificed.

Local services and facilities such as the transportation network, schools, police and fire department and park system will also feel the pressure of this population increase. Each of these areas of secondary impact would typically be analyzed as facilties plans are completed for the urbanizing areas around the City of Spokane.

Relationship of Alternatives to Regional Air Quality

Construction activities can be expected to produce an undetermined quantity of dust, which may be considered a nuisance condition by residents adjacent to construction sites. The larger particles will settle out locally, while the smaller particles may remain indefinitely suspended and contribute to the existing ambient suspended particulate problems. Although the quantification of impacts is difficult at best, a qualitative judgement on the relative impacts of the three basic alternative projects can be made. One important factor is the length of construction. Alternatives 1 and 2 would be constructed over a 2- to 3-year time period, while Alternative 3 would take 8 to 10 years. Another factor is that an open pit excavated for either storage basins or satellite treatment facilities would likely emit more particulates than an equal area of pipeline trench. A large open pit is more conducive to generating dust than narrow trenches. Since Alternative 1 necessitates the greatest acreage of large excavations (approximately 30 acres), and its construction period is 2 to 3 years, it will create the greatest impact on ambient suspended particulates. Alternative 2 requires approximately 19 acres of excavation over a similar construction period. Therefore, Alternative 2 would create the second largest impact. Since Alternative 3 would be constructed over 8 to 10 years, and it requires no large open excavations, it would produce the least impact on ambient suspended particulates. Through the use of standard construction practices (such as the use of water to abate dust), none of the alternative projects is likely to significantly affect air quality. These construction activities should therefore not interfere with implementation of air quality strategies to meet federal air quality standards.

Through the use of construction equipment, construction activities will also generate other pollutants. This equipment will emit uncalculated quantities of hydrocarbons, nitrogen oxides, sulfur oxides, carbon monoxide, and particulates. The quantity of each pollutant emitted is a function of the type of equipment used, and the duration of use. Only carbon monoxide and particulate emissions are of major concern, since these are the only two pollutants that presently pose a significant ambient air quality problem. Alternative 1 involves the heaviest use of construction equipment, and would take 2 to 3 years to complete. It would therefore produce the greatest impact. Alternative 2 involves the second heaviest use of equipment and it would also take 2 to 3 years to complete. It would produce the second largest impact on air quality. Alternative 3 would utilize the least amount of heavy construction equipment, and it would take 8 to 10 years to complete. It would therefore produce the least impact on air quality. Utilizing reasonable construction practices, it is not likely that any of the proposed alternatives would significantly affect ambient air quality. Similarly, construction activities would not likely interfere with strategies to meet federal air quality standards.

Project Alternative 3 would allow for eventual regionalization of wastewater treatment in the Spokane area by freeing capacity in both the city interceptor system and treatment plant. This would be an impetus to growth in outlying areas even though wastewater treatment facilities are not now a serious constraint to growth. As these areas grow, whether from hooking into the city system or constructing wastewater facilities of their own, air quality will undoubtedly suffer. Increases in auto traffic are closely tied to increases in population, and cars are typically the biggest contributors to air pollution. Therefore, it is important that facilities planning efforts for outlying county areas consider the long-term air quality implications of the growth those facilities are designed to accommodate.

Long-Term Effects of New Facilities on Adjacent Land Uses

Alternative 1 - Storage Basins and Relief Sewers

Under this alternative, available interceptor and main sewage treatment plant capacity would always be required for storm flow, thus restricting expansion of sanitary sewer service to unsewered areas. Relief sewers would eliminate backup problems which would have a beneficial impact on land use. The construction of a storage basin at Peaceful Valley may result in permanent removal of housing. The land use plan for city shows this as an area planned eventually for medium and high density residential development (Spokane City Plan Commission, 1968). Removal of existing older housing would, therefore, not necessarily conflict with long-range plans, but may tend to accelerate conversion of the area to more intense land use. Storage of untreated sewage may result in significant odor problems, which would create serious land use conflicts in existing and proposed residential and recreational areas where basins are proposed.

Alternative 2 - Satellite Treatment and Relief Sewers

This alternative would not free additional capacity in the sewage treatment plant and would not, therefore, influence development in unsewered areas. This alternative would be identical to storage basins in terms of the effect on eliminating backup problems. The alternative may result in some permanent conversion of land use for construction of facilities in the Peaceful Valley area. Although treatment facilities will be underground, chlorination storage facilities would be above ground, probably in fenced storage buildings. Due to safety and aesthetic considerations, this may conflict with adjacent uses in developed areas.

Six of the 14 treatment plant sites would be located adjacent or close to residential development. Should odors result due to chlorination or other operational problems, there would be a serious conflict with adjacent land use. This would also be the case in park lands where facilities are planned. The presence of treatment facilities in Riverfront Park may conflict with existing and proposed uses in the park if odors or other aesthetic problems result.

Alternative 3 - Separate Storm Sewers

A portion of the capacity in the existing trunk and interceptor sewer system and treatment plant is reserved for storm flows. With this alternative, stormwater would no longer flow to the treatment plant, freeing an estimated 10 to 12 mgd of sewage treatment capacity (Gellner, pers. comm.). This additional capacity could be used to extend service to unsewered areas, potentially facilitating development. With minor modifications and a relatively small additional cost, the sewage treatment plant could be further upgraded to provide an additional 20 mgd of capacity. No determination has been made as to when and where the additional capacity would be utilized. The city is almost entirely served by the community sewage collection system. The largest unsewered area in the city with development potential is in the southeast corner.

The largest unsewered area contiguous to the city is sprawling Spokane Valley to the east. The rapidly growing suburban area has an estimated population of 60,000 (U. S. Department of Army, Corps of Engineers, 1976; Technical Report). However, the greatest demand for sewerage service comes from lesser populated North Spokane. North Spokane is the area generally north of Francis Avenue and including both unincorporated areas and areas within the city limits. Incorporated areas are served by small collection systems leading to some interim form of treatment facility, either nonoverflow lagoons or package plants. Operation of the lagoons has not been satisfactory. Unincorporated areas are predominately served by on-site disposal systems which are subject to a large number of failures due to marginal soil conditions. If the additional capacity were used to allow a community sewer system in North Spokane, additional development and population growth would be facilitated. It should be noted that North Spokane's 20,000 population is expected to increase rapidly in the future as is the Spokane Valley area (U. S. Department of Army, Corps of Engineers, 1976; Technical Report). Therefore, additional development could theoretically be accelerated by this alternative, but growth would probably occur with or without extension of sewerage services.

Separate storm sewers would have a beneficial impact by eliminating sewage backup problems which now adversely impact a variety of land uses. The most notable areas where improvements would occur are in the older residential sections of the central and western south hill, and to a lesser degree in the north side residential areas. The older residential areas include some of the poorest quality housing in the city, and elimination of backup problems would be extremely beneficial. Although planning department and other city personnel identified no areas where development has actually been inhibited by sewage backup problems, a recent report for the Spokane City Plan Commission recommends that no additional growth be permitted in sewerage backup areas or unsewered areas (Spokane City Plan Commission, 1976a). Such areas constitute a large percentage of the city and if the recommendation were endorsed, would significantly inhibit future development in the city.

Expanded Sewage Treatment Plant. Should the sewage treatment plant be expanded to accommodate additional flows from outlying areas, there would be a minor impact on land uses in the vicinity of the plant. The existing site has been laid out to accommodate the additional facilities required for plant expansion. The treatment plant site is owned by the City of Spokane. Land surrounding the site and opposite the plant on the north shore, is owned by the State of Washington, and is part of Riverside State Park. Above the site, low density residential development is continuous along Northwest Boulevard. The treatment plant site is zoned for utilities, with adjacent land to the north and south zoned for parks. Residential lands are zoned for low density development. The site is within the planning area identifed in city documents as NW Neighborhood 10 (Census Tract 10) which encompasses a total of 941 acres (Spokane City Plan Commission, 1968). The Land Use Plan indicates the area will remain predominately low density residential, with park and utility zoning remaining unchanged. The 1970 population of Neighborhood 10 was estimated at 5,697, which is expected to increase very slightly to a saturation point of 5,800 (Spokane City Plan Commission, 1975). Conflicts between the existing sewage treatment plant and adjacent land use have related primarily to complaints by residents along Northwest Boulevard and the surrounding area of odor from the plant (Hess, pers. comm.).

The expanded treatment plant is not expected to appreciably alter the odor problem. Other significant land use conflicts are not anticipated due to the extensive city and state lands buffering the treatment plant site.

Klicker Storage Suboption. This alternative would have a number of adverse impacts on adjacent land use. The surface basins with their attendant aesthetic, odor and public safety problems, could substantially reduce the desirability and quality of residential and recreation areas where basins are proposed. Construction of the Bridge Street storage reservoir would preclude the planned development of this area as a future residential area, which would conflict with the city's master plan for this area (Spokane City Plan Commission, 1975). Open storage may also preclude or jeopardize future recreation development planned on the north shore of Riverfront Park. Benefits due to elimination of sewage backup would be the same as Alternative 1.

Latenser Plan. The extent of urban development adversely affected by this proposal would be less than with Alternative 1. Long-term effects of the Clark Street reservoir would depend on whether the facility were below or above the surface. A surface reservoir would require permanent removal of housing in the Peaceful Valley area, and would periodically pose serious problems for residents due to aesthetic, odor, and safety factors. An underground facility may create serious odor problems, but would not be as detrimental as a surface lagoon. The open reservoir in Riverside State Park would eliminate future recreation development in that vicinity. This may not be acceptable to the State Parks and Recreation Commission, because they plan to develop the area for equestrian use in the near future (Heiser, pers. comm. [a]). This alternative would permanently remove a small amount of agricultural land from production, but would potentially allow conversion of nonirrigated land and open space to more intensive agricultural uses.

Combination Concept. Storage basins near Riverfront Park (6B) in Peaceful Valley (8B) and on Northwest Boulevard (14B) could have a long-term adverse impact on adjacent land uses under this alternative. Odors emanating from stored wastewater could stimulate complaints from nearby residents or recreationists. As mentioned under Alternative 1, the Peaceful Valley storage basin could accelerate planned land use conversion from low to medium or high density residential uses. None of the other storage basins (5B, 10B, 16B) should have a long-term effect on adjacent land uses. Separate storm sewers planned in drainage areas 1, 2, 3, 4, 7, 9, 11 and 13 (Figure 2-7) would not improve sewer backup problems in the areas with the most extensive problems, but relief sewers in the other drainage areas would.

Potential Effect Upon Historic and Archeological Resources

A cultural resource survey for this project was prepared by staff of the Anthropology and History Departments of Oregon State University. Their full report (Hartman and Robbins, 1978) is not included herein, but may be reviewed in its entirety at offices of the U. S. Environmental Protection Agency in Seattle, or the City of Spokane Department of Public Works, Spokane City Hall. The following discussion has been excerpted from the full report.

Prehistory and Native Peoples

The Indians of the Columbia Plateau were primarily Salish and Shahaptian speakers, and archeological evidence indicates that people were living on the plateau between 8 and 13 thousand years ago. When the whites first encountered them, these Salish-speakers referred to themselves as "Spukanee," which means Sun People or Children of the Sun. Eventually the word was rendered in English as Spokan (Ruby and Brown, 1970).

Verne Ray (1936) has divided the Spokans into three groups: the lower, middle and upper. The Upper Spokan lived in the area of the present City of Spokane. Ray (1936) has ethnographic data for several villages in the vicinity of Spokane. Archeological verification of these sites is difficult as the development of the downtown area has all but obliterated any surface signs of prehistoric occupation.

A check for archeological site data was made at the Washington Archeological Research Center, Washington State University, Pullman. Few archeological sites are recorded for the Spokane area; no systematic on-ground investigation has been made. Several site areas have been located through a literature search by Sarah Keller of Eastern Washington University, but this information is contained in an as yet unreleased draft of a historic landmarks survey filed with the City Planning Commission.

Potential For Impacts

Unlike Seattle, Spokane does not have a historic "old town" buried beneath its streets. Except for fill areas on both sides of the river adjacent to the Monroe Street Bridge, most of the street construction has been in accord with the natural topography. Excavation may expose bricks, especially in the older sections of the city where they were often used as the original pavement. Excavation may also turn up parts of the old wooden sewer system (Fahey, pers. comm.).

One local historian, Edmund T. Becher, claims there are "persistent rumors" of underground Chinese gambling and opium dens in "Chinese Alley", the block bounded by Trent and Main, and Bernard and Brown. These reputed underground dens were under the alley rather than the street (Becher, pers. comm.). The Chinese also congregated in great numbers along lower Hangman Creek during the heyday of railroad building in the 1880s and thus there is the possibility of discovering evidence of their stay (Garrett, pers. comm.).

When the city was building its early street system on the north side of the river, there are reports that the digging and blasting disrupted some burial grounds. Early burial areas in Browne's Addition also may have been paved over (Garrett, pers. comm.). James Glover claims that a cemetery near Fourth and Pine was used by Christian Indians who buried their dead in the earth (Durham, 1912).

Places within Spokane that have been included on the National Register of Historic Places are listed at the end of this section.

The greatest potential impact of this project on cultural resources is the possible disturbance of archeological sites along the Spokane River, especially in the Peaceful Valley area and in the vicinity of the Downriver Golf Course. Brief inspections of the proposed storage basin sites failed to locate archeological materials, but virtually all low-lying areas within 1/4 mile of the river should be considered sensitive for archeological sites. (Storage basin site 16B, which was only recently identified as a potential storage site by the City of Spokane, has not been surveyed on the ground. If the storage option is eventually selected for more detailed consideration, this site will be checked for archeological resources.) Basin sites 2B, 4B, 5B, and 6B (Alternatives 1, 2 and the Klicker Plan) appear to be in locations which are mentioned as sites in the literature. Review of the proposed facilities sites by the Washington Archeological Research Center indicates that construction of storage basin/treatment plant sites 6B, 7B, 8B (Alternatives 1 and 2, Klicker Plan, Combination Concept) may affect known cultural resources. Site 6B could affect Indian burials at the Masonic Temple, while sites 7B and 8B could affect historic and prehistoric Indian encampments in the Peaceful Valley area. In addition, the proposed intermediate storage basin of the Latenser Plan (located just across the river from the Spokane treatment plant) could affect the Fort George Wright historic military trash dump (on the National Register of Historic Places) and historic or prehistoric Indian camp sites.

It is nearly impossible to discover such sites in an urban environment based solely on surface reconnaissance, and therefore construction in such areas should be preceded by archeological testing, or at the very least should be closely monitored.

If any archeological materials are unearthed in the course of construction, they should be brought to the immediate attention of qualified professionals and the State Historic Preservation Office in Olympia should be consulted for guidance. Finally, detailed attention should be given to the recent report, *Historic Landmarks Survey: A Report and Site Inventory of Spokane's Historic Resources*, (Keller, n.d.) which can be consulted at the City Planning Commission Office, Spokane (when it becomes available). The archeological component of this study should contain relevant data on the Spokane CSO abatement project area. (Three unsuccessful attempts were made to obtain the Keller report. Site locale data are on file both with the City of Spokane and the Washington Archeological Research Center in Pullman. Both should be consulted for precise archeological site locations near facilities eventually constructed.)

Listings on the National Register of Historic Places for Spokane

Browne's Addition Historic District. A well preserved residential section west of the city's center. It includes examples of every residential style of architecture fashionable in the Pacific Northwest between 1880 and 1930.

Cowley Park. Located on South Division between Sixth and Seventh Avenue. The park marks the presence of several structures erected by Reverend Henry Cowley and his family, one of the first four families to settle in Spokane in 1874.

Davenport Hotel. Located at 807 West Sprague and 512 Post. Built in 1914, the building was famous for its architecture and imaginative service.

Finch House. Located at West 2340 First Avenue and South 104 Poplar. This is a Georgian Revival mansion built in 1893.

Flour Mill. Located at 621 Mallon and built in 1895.

Fort George Wright Historic District. Originally designed as a replacement for Fort Spokane and used from 1897 to 1958. The fort is famous for its tree-lined lanes and red brick buildings.

Glover House. Located at 321 Eighth Avenue and built in 1888 for James Glover, the founder of Spokane.

Great Western Building. Located at Riverside Avenue and Lincoln Street. Built in 1890.

Hyde Building and Annex. Located at Riverside Avenue and Wall Street. The main building was constructed in 1890, the annex in 1908.

Monroe Street Bridge. Built in 1912, its 290-foot arch was the longest in the world at that time.

Review Building. Located at Monroe Street and Riverside Avenue. Built in 1889, this six-story building is an architectural and historical landmark.

Riverside Avenue Historic District. Once known as the "Civic Center" because of the concentration of monumental buildings in one area, a majority of which still survive.

Spokane County Courthouse. Located at West 1116 Broadway. Built in 1895 in French Renaissance style.

Westminster Congregational Church. Located at Fourth Avenue and Washington Street. Built in 1890, the building is the first stone church built in Washington.

Chapter 5

PROPOSED ACTION

Introduction

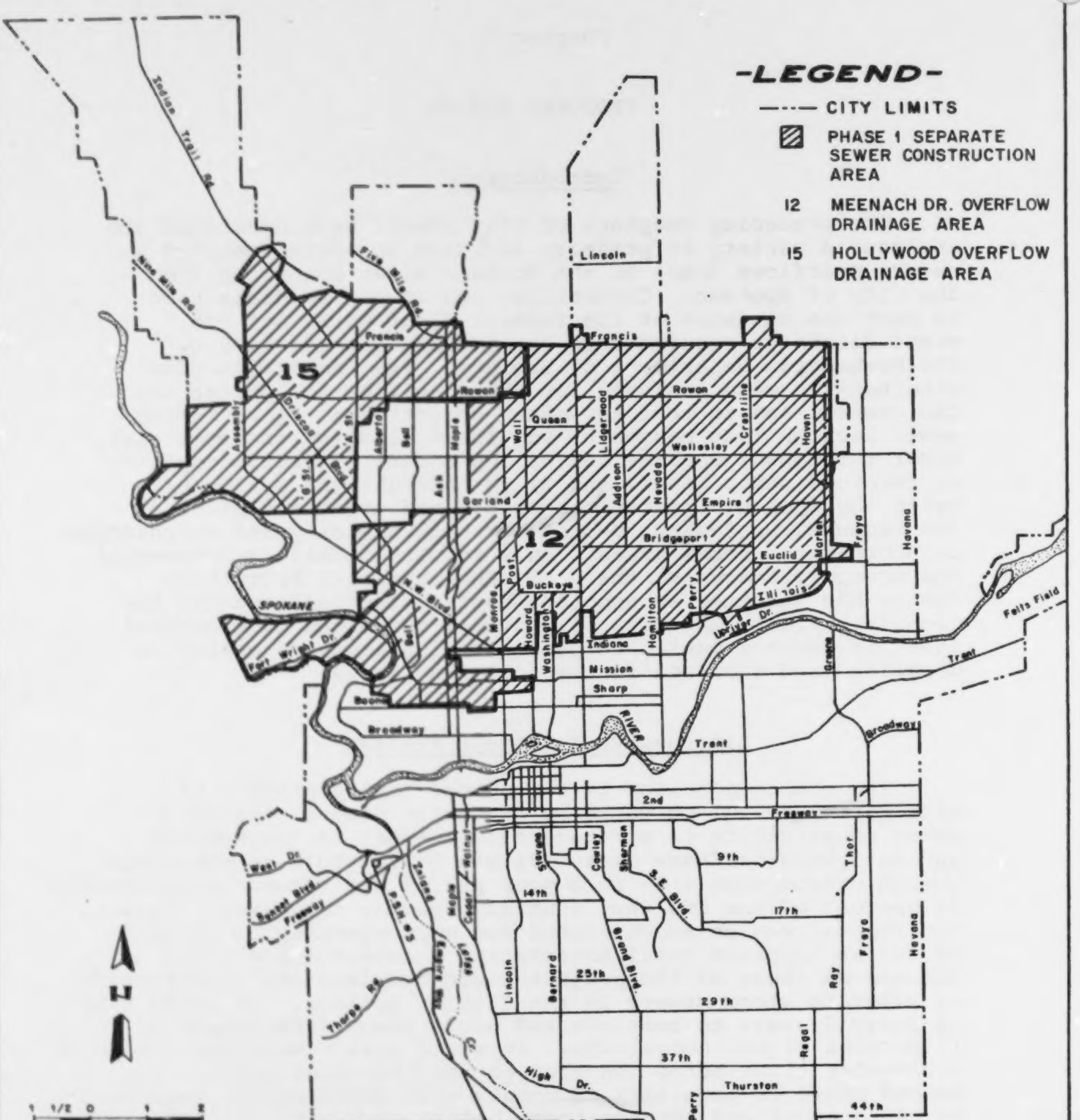
The preceding chapters of this report have described and analyzed a variety of projects designed to abate combined sewers overflows (CSO) to the Spokane River emanating from the City of Spokane. Controlling CSO is an immediate need to meet the mandates of the federal Clean Water Act and waste discharge requirements established and enforced by the Washington Department of Ecology. The facilities plan alternatives were analyzed for their ability to correct the CSO problem and to meet two other objectives: 1) to remedy sewer backups into basements and local flooding problems that occur throughout Spokane due to inadequate hydraulic capacity in combined sewer lines, and 2) to maintain the option of using the Spokane interceptor system and treatment plant as the regional wastewater system for both the city and surrounding unincorporated urban areas. As a result of this environmental and economic analysis, the U. S. Environmental Protection Agency has selected an apparent best project alternative for consideration by the City of Spokane, concerned governmental agencies and the public in general. The proposed action is described and analyzed in the following pages.

Alternative 3 Project Phasing

The proposed action is the phased implementation of Alternative 3. There would be two major phases, the first being construction of separate storm sewers in the Meenach and Hollywood drainage areas (Figure 5-1). This construction should extend over a 3- to 5-year period and remove approximately 84 percent of the CSO that annually reaches the river. This CSO removal can be accomplished for approximately 39 percent of the anticipated total Alternative 3 construction cost. The second phase of the project would complete the construction of separate storm sewers in the City of Spokane. It would take at least 5 years to complete and would remove the remaining 16 percent of the annual CSO. It would also remove the remaining stormwater flows being conveyed to the treatment plant. The second phase is necessary to comply with NPDES permit mandates on CSO control and AWT treatment before discharge to the river, and to free-up capacity in the Spokane wastewater system for outlying county areas. The order in which other parts of the city are given separate sewers would be determined by the City of Spokane. Some priority ranking could be established on the basis of CSO control and a schedule to meet project objectives.

FIGURE 5-1

PROPOSED ACTION - PHASE 1


-LEGEND-
CITY LIMITS
▨ PHASE 1 SEPARATE SEWER CONSTRUCTION AREA
12 MEENACH DR. OVERFLOW DRAINAGE AREA
15 HOLLYWOOD OVERFLOW DRAINAGE AREA
15
12
Indian Trail Rd.
Nine Mile Rd.
Five Mile Rd.
Lincoln
Francis
Rowan
Queen
Wellesley
Empire
Garland
Bridgeport
Euclid
Buckeye
Illinois
Indiana
Mission
Sharp
Boone
Broadway
Trent
2nd
Freeway
9th
14th
17th
25th
29th
37th
Thurston
44th
Assembly
Driscoll Blvd.
Alberta
Ash
Maple
Wall
Lidgerwood
Addison
Nevada
Crestline
Haven
Market
Freya
Havana
Monroe
Post
Howard
Washington
Hamilton
Perry
Greene
N.W. Blvd.
Fort Wright Dr.
SPOKANE
RIVER
Upriver Dr.
Felts Field
West Dr.
Sunset Blvd.
Freeway
Thorpe Rd.
Walnut
Cedar
Stevens
Cowley
Sherman
S.E. Blvd.
Grand Blvd.
Lincoln
Bernard
Thor
Ray
Regal
High Dr.
Perry
MILES
1 1/2 0 1 2

SOURCE: BASEMAP
MODIFIED FROM SPOKANE CITY DEPARTMENT
OF PUBLIC WORKS, 1977, EXHIBITS

Phasing has been suggested because there is insufficient federal and state grant money to finance the entire project at this time. Federal and state governments make annual allocations of funds to finance water pollution control projects. There is a limited supply of funds available and allocations from the federal government to the various states vary from one year to the next. The Washington Department of Ecology develops an annual priority list of projects based on the funds available in a given year and the relative pollution control merits of projects within Washington. The level of funding available is not known more than 2 to 3 years in advance. Therefore, it is impossible to determine the exact level of federal and state participation in funding of Phase 2 of Spokane's CSO abatement project.

Probable Funding Action

The proposed action is considered a multi-purpose project for purposes of calculating federal funding. A multi-purpose project is designed to solve more than just a water pollution problem; in this case it also seeks to remedy a local sewer backup and drainage problem and to allow regionalization of sewage treatment and disposal. If the cost of a multi-purpose project (Alternative 3) exceeds the cost of the single purpose pollution control project (control of CSO only) then EPA regulations require that the cost of the multi-purpose project be allocated between pollution control and other purposes, with only the pollution control component being eligible for EPA funding. If on the other hand the multi-purpose project is less costly than the single purpose pollution control project, then 100 percent of the project is eligible for EPA funding.

Table 5-1 compares the total annual cost of the single purpose project with that of Alternative 3 (both phases). It shows that the multi-purpose project is more costly in spite of the credit ($3.03 million) given it for its regionalization potential. The regionalization allowed by Alternative 3 could eliminate the need for constructing other water pollution treatment and disposal facilities in the Spokane Valley. Table 5-2 shows how this credit was developed. It illustrates the cost savings in water pollution control that can be achieved by using the existing Spokane treatment plant to treat and dispose of Spokane Valley wastewater. The alternative is to construct a new 10 mgd secondary waste treatment facility (with phosphorus removal) for the valley. The average annual equivalent cost of constructing a new secondary treatment plant (with phosphorus removal) and associated trunk sewers is estimated to be $4,074,000; the annual equivalent cost for constructing trunk sewers, expanding the city treatment plant, and hooking into the city system after sewer separation is estimated to be $1,042,390. The difference between these two figures ($3,032,000) is the cost credit applied to Alternative 3.

Table 5-1

MULTI-PURPOSE AND POLLUTION CONTROL ALTERNATIVE COST COMPARISON

Project	Average Annual Cost Millions of Dollars
Multi-Purpose Project (Alternative 3)	6.81
Single-Purpose Pollution Control Project	
Storage Basins (one overflow/year)	3.15
Added facilities required for the treatment and disposal of suburban flows*	3.03
Total	6.18

*This is a credit to the multi-purpose storm drain project, because the construction of separate storm drains would free-up interceptor capacity and treatment capacity at the existing plant, which means that new treatment facilities would not have to be constructed in the Spokane Valley. See Table 5-2 for an explanation of the credit calculation procedure.

Table 5-2

COST CREDIT CALCULATION FOR ALTERNATIVE 3

Regional Sewerage Costs for the Period 1985 to 2005:**

With Storage Basins in City of Spokane	Present Worth Costs
Spokane Valley Secondary Treatment Plant*	$43,000,000
Additional Trunk Sewers	3,256,300
Total Present Worth Costs	46,256,300
Average Annual Equivalent Cost	4,074,000
With Storm Separation in City of Spokane	
Additional Interceptor from Proposed Valley Treatment Plant Site to Existing Interceptor	1,558,680
Additional Storm Separation in the Erie St. Drainage Basin	1,844,600
Additional Trunk Sewers	256,540
City Treatment Plant Expansion (1985)	8,175,920
Total Present Worth Costs	11,835,740
Average Annual Equivalent Cost	1,042,390

Cost to be added to single purpose pollution control cost to make it comparable for regional water pollution control purposes to Alternative 3.
$4,074,000 - 1,042,390 = 3,032,000

* With phosphorus removal.

** The credit calculation used a planning period of 1985-2005 rather than 1980-2000 because it is estimated that sewer separation would not make capacity in the city system available until 1985 at the earliest.

In all of these calculations, the cost of both phases of Alternative 3 was used. However, the allocation of costs between federal, state and local entities has not presently been established firmly beyond Phase I. This is due in part to the fact that the availability of federal and state grant money fluctuates from year to year and priority lists for allocation of funds are developed only 2 to 3 years in advance. A more detailed identification of specific project costs is presented in a following section.

First Phase Project Impacts

Introduction

Earlier discussions have dealt with the total impact of Alternative 3. Because the apparent best alternative is a phased Alternative 3, a brief discussion of the impacts of the first phase is desirable to put it in proper perspective. The following paragraphs highlight the major differences in impact that might be expected between first phase sewer separation and total sewer separation.

Construction Disruptions

Phase 1 construction would require installation of about 90 miles of new stormwater interceptors throughout the northern 1/3 of Spokane (see Figure 5-1). This area is primarily residential, but there are also some commercial, recreational and public service land uses that would be temporarily impacted by the construction. Residential impacts would be significant in most parts of the two drainage areas. Noise, dust, traffic disruption, and interruption of access are the most significant impacts, but all would be of short duration. While the entire construction project may take from 3 to 5 years to complete, specific sections of road should be affected for only 2 to 3 weeks. All construction should be confined to existing road rights-of-way. Other potentially significant land use disruptions would occur at Downriver Golf Course; strip commercial development on Garland Street between Jefferson and Howard; Franklin, Corbin, and A. M. Cannon Parks; Clark Playground; and Madison, Garland and Willard Schools. None of the city's major commercial or industrial areas would be affected by the first phase construction.

Employment and Economic Impacts of Construction

First phase construction costs would be about $24,980,000 and would be spread over about 5 years of time. Using the same employment multiplier assumptions presented in the Chapter 4 impact section, this would generate a total payroll of $7,494,000 and would employ 100 construction workers for the 5 years. This represents about 11 percent of the current employment of construction workers. Approximately 50 additional jobs in the service and commercial business sector would be generated by an increase in construction activity. Building materials sales would total about $8,326,700 during Phase 1. These levels of economic stimulus can be compared to the other alternatives by reviewing Table A-4.

Impact on Surface Water Quality

The first phase of the proposed action would remove approximately the same percent of Spokane's annual waste load to the Spokane River as would the Combination Concept (Table 4-5). About 15 percent of the BOD_5 would be removed; little effect upon dissolved oxygen concentrations in the Spokane River or Long Lake would be expected. Suspended-solids loading would increase by 15 percent; however, less harmful mineral solids from surface runoff would be replacing sewage-related organics. Total nitrogen and total phosphorus loading contributed to the river by the city would be reduced less than 5 percent; this reduction would represent around 1 percent of the annual load to Long Lake (Table 4-6) and would probably be insignificant in improving eutrophic conditions.

Ability to Alleviate Public Health Concerns

First phase construction would eliminate about 84 percent of the annual volume of CSO going into the Spokane River. The post-construction annual volume would be less than 86 million gallons as compared to the present average of about 547.1 million gallons. However, the river would continue to be affected by overflows from the remaining 25 CSO discharge points. The number of days the river would be affected by CSO would remain about the same as present, but because of the smaller volumes of CSO involved, dilution of wastes would be much greater. The Front Street CSO, which is currently the third largest in the city, would receive at least an 80:1 dilution from the river even in low flow periods (1,000 cfs in the river). In effect, the public health threat from water contact in the city portion of the river would remain as it is at present. From Fort Wright Bridge to Long Lake, one could expect considerably lower coliform bacteria concentrations after CSO events than are now recorded, but some threat to public health would continue until all CSOs were eliminated. This emphasizes the importance of following through with later phases of the proposed action.

Aesthetic problems created by the presence of large waste solids in the river after overflows would only partially be corrected, because periodic unscreened CSOs would continue from 25 overflow points.

It is difficult to assess the impact that Phase 1 would have on the sewer backup problem in Spokane because the location and severity of backups is not well documented. Based on the mapping of backup events that is available, it appears that separate sewers in Hollywood and Meenach drainage areas would solve a relatively small part of the problem. The areas that have reported the most frequent backup and flooding are in the central and southern sections of town. Meenach and Hollywood drainage areas are in the north. Central business district conditions would not be improved by Phase 1.

Construction Costs and Cost Sharing

As noted earlier, Phase I total construction costs are estimated to be $24,980,000. Table 5-3 below summarizes the costs and a possible cost sharing for both Phases 1 and 2 of the proposed action. These figures can be compared to other project alternatives by referring to Table 4-9. It is important to note that federal and state funding may not be available for funding of Phase 2 when it is constructed.

Table 5-3

SUMMARY OF CONSTRUCTION COST SHARING*-PROPOSED ACTION

	Total Construction Cost	EPA	State of Washington	City of Spokane
Phase 1	$24,980,000	$18,740,000	$3,750,000	$2,490,000
Phase 2	39,070,000	23,430,000	4,680,000	10,960,000
Total	$64,050,000	$42,170,000	$8,430,000	$13,450,000

*Allocations for Phase 1 were made assuming 75 percent federal funding, 15 percent state funding and 10 percent local funding because this first phase was determined to be 100 percent eligible for grant funding. The entire project was determined to be 87.8 percent grant fundable; this accounts for the less than 75 percent federal participation in Phase 2. It is important to note that Phase 2 sharing is only speculative at this time because grant fund availability and priority for grant money distribution is not known more than 2 to 3 years in advance.

The comparisons in Table 4-9 show that the proposed action gives the city its second lowest participation cost in terms of capital outlay. There are two main reasons for this. First, separate sewer construction avoids the need for relief sewers, which are viewed as a drainage control rather than pollution control feature and are therefore not funded by EPA or the State of Washington. The total cost of relief sewers would be borne by the city. Secondly, because sewer separation effectively frees up capacity in the city system. which could be used to provide sewer service to outlying county areas, a cost credit is awarded to this option. In effect, the added cost that would be required to provide new wastewater treatment facilities for outlying areas is credited against the total cost of sewer separation because the cost of new treatment facilities could be avoided by tying-in outlying areas to the city system. This cost credit calculation was presented earlier in Table 5-2. The Klicker Plan has a lower participation cost for the city because it too avoids the need for relief sewers and it has a lower total construction cost. However, it does not provide for regionalization and its proposed method of back-up relief (individual check valves and storage tanks) is not an effective long-term solution to basement flooding.

Public Maintenance Costs

Annual operation and maintenance costs during Phase 1 are estimated at $67,620. Based on this total, the alternative would require employment of 2 to 3 additional persons in the city utilities department during Phase 1. Maintenance costs during Phase 2 would increase by $85,310 annually; these costs are expected to continue for the remainder of the service life of the project (1978 dollars). These added O&M costs would be offset by a reduction in city costs associated with clean-up of sewer backups. No dollar value is available for these current clean-up costs. Additional street maintenance costs would be the same as described for Alternative 3 in Chapter 4. However, the additional cost to the city would be spread over a longer time period due to the phasing of construction work, and would, therefore, require less municipal outlay on an annual basis.

Impact on Property Values and Taxes

The phased implementation of Alternative 3 would have essentially the same impact on property values as would implementation of Alternative 3 in a single phase. No property would be removed from municipal tax rolls, and a long-term beneficial impact in property values may occur should additional areas be sewered within the city as a result of storm sewer construction. The value of property now having sewage backup problems should increase after construction is completed.

Total sales tax revenue due to the sale of construction materials would be the same, but would be dispersed over a longer time period. Phase 1 would not require construction in Spokane's central business district; therefore, adverse effects on downtown business activity or sales volume would be delayed until Phase 2. Sales tax income should remain at about present levels in the downtown area during the first phase.

Changes in Sewer Use Rates

Due to the eligibility of the first phase of this alternative for full 75 percent federal grant funding, increased user charges or increased ad valorem taxation would only be required to finance operation and maintenance costs and the local 10 percent share of construction costs.

User charges are expected to increase about $6.73 per year per connection. Table 5-4 summarizes the impact of increased user charges. Should ad valorem taxation be utilized as a method of financing, the current tax rate would be increased by an estimated $.21 per $1,000 of assessed valuation, for a total tax rate of $19.171 per $1,000. Table 5-4 summarizes the estimated increase for residential and commercial users should ad valorem taxation be utilized.

Influence on Spokane Treatment Plant's Ability to Serve Outlying Areas

Phase 1 of the proposed CSO control measure will reduce peak wastewater flows into the Spokane treatment plant during storms or periods of rapid snowmelt, but the reduction will be less than 10 percent. Due to the physical structure of the Meenach and Hollywood overflow points, very little peaking in flows to the plant occurs during storm periods. Most peak flows are now bypassed to the river. The estimated annual decrease in flows to the treatment plant after construction of storm sewers is 595 million gallons; no estimate is available for reduction during a single storm event. This reduction in peak flow will not be sufficient to allow annexing of large outlying areas to the Spokane treatment system. Also, it will not allow total conversion of the two primary stormwater clarifiers, which is necessary to eventually expand the plant's secondary treatment capacity to 60 mgd and meet EPA and DOE effluent requirements. Therefore, in order to meet the project's regionalization objective, the second phase of the proposed action must be completed. Separate storm sewers must be constructed in those parts of the city that are now contributing large storm flows to the

Table 5-4

ESTIMATED INCREASE IN USER CHARGES OR AD VALOREM TAXATION
REQUIRED TO FINANCE PHASE 1 OF PROPOSED ACTION*

Annual Residential User Charge Increase**

Current Residential User Charge	Estimated Increase	Percent Increase	Anticipated Total Annual User Charge
$38.40/yr.	$6.73/yr.	18.0	$45.13/yr.

Ad Valorem Tax Increases - Residential Property

Example Value Per Res. Unit	Current Tax Rate***	Estimated Tax Increase***	Percent Increase	Tax Per Ave. Residential Unit Without Project	Tax Per Ave. Residential Unit With Project	Annual Dollar Increase
$35,000	18.961	.21	1.0	$664	$671	$7.00/yr.

Ad Valorem Tax Increase - Industrial and Commercial Property

Example Value Per unit	Current Tax Rate***	Estimated Tax Increase***	Percent Increase	Tax Per Ave. Unit Without Project	Tax Per Ave. Unit With Project	Annual Dollar Increase
$192,000	18.961	.21	1.0	$3,641	$3,680	$39.00/yr.

*See Table 4-15, 4-16 and 4-17 to compare these increases with increases expected for other proposed alternatives.

**Based on 56,000 sewer connections.

*** Per $1,000 of assessed (fair market) valuation with a total city assessed valuation of $1,835,660,452.

treatment plant (but perhaps lower CSO volumes) before North Spokane or Spokane Valley wastewater flows can be treated at the Spokane plant.

Chapter 6

AFFECTED ENVIRONMENT

Introduction

The AFFECTED ENVIRONMENT provides a brief description of the setting into which the proposed CSO abatement project would be inserted should it be implemented. The section is not intended to supply all of the specific background environmental data needed to assess the impacts of the various CSO abatement alternatives. Instead, it provides a general picture of metropolitan Spokane to readers unfamiliar with the area. If needed, detailed descriptions of the environment have been included in the ENVIRONMENTAL CONSEQUENCES chapter or the appendix.

Location

The City of Spokane is located in eastern Washington state approximately 20 miles west of the Idaho-Washington state line and 110 miles south of the U. S.-Canadian border It sits astride the Spokane River almost 350 miles inland from the Pacific Ocean and approximately 280 freeway miles east of Seattle, the state's largest metropolitan area (see Figure 6-1). Spokane is the seat of government for Spokane County and is located near the county's center.

The primary area of investigation for this report is within the Spokane city limits and along the Spokane River from the city to Long Lake Dam. The Crab Creek drainage, from its headwaters to the Odessa area, has also been studied in some depth, as it is the proposed area of wastewater reuse for one project alternative. These segments of the project study area are mapped in Figures 6-1 and 4-7.

Climate

The Spokane area typically has a mild, arid climate during the summer months and a cold, coastal-type climate in the winter months. Its location east of the Coast and Cascade Range orographic barriers limits annual precipitation totals to around 18 inches. Usually about 70 percent of the precipitation falls in the winter period between October 1 and March 31, and half of this total is snow. Most of the storms approach from the west and southwest, originating in the Gulf of Alaska and eastern Pacific Ocean. On rare occasions the area is influenced by dry continental air masses intruding

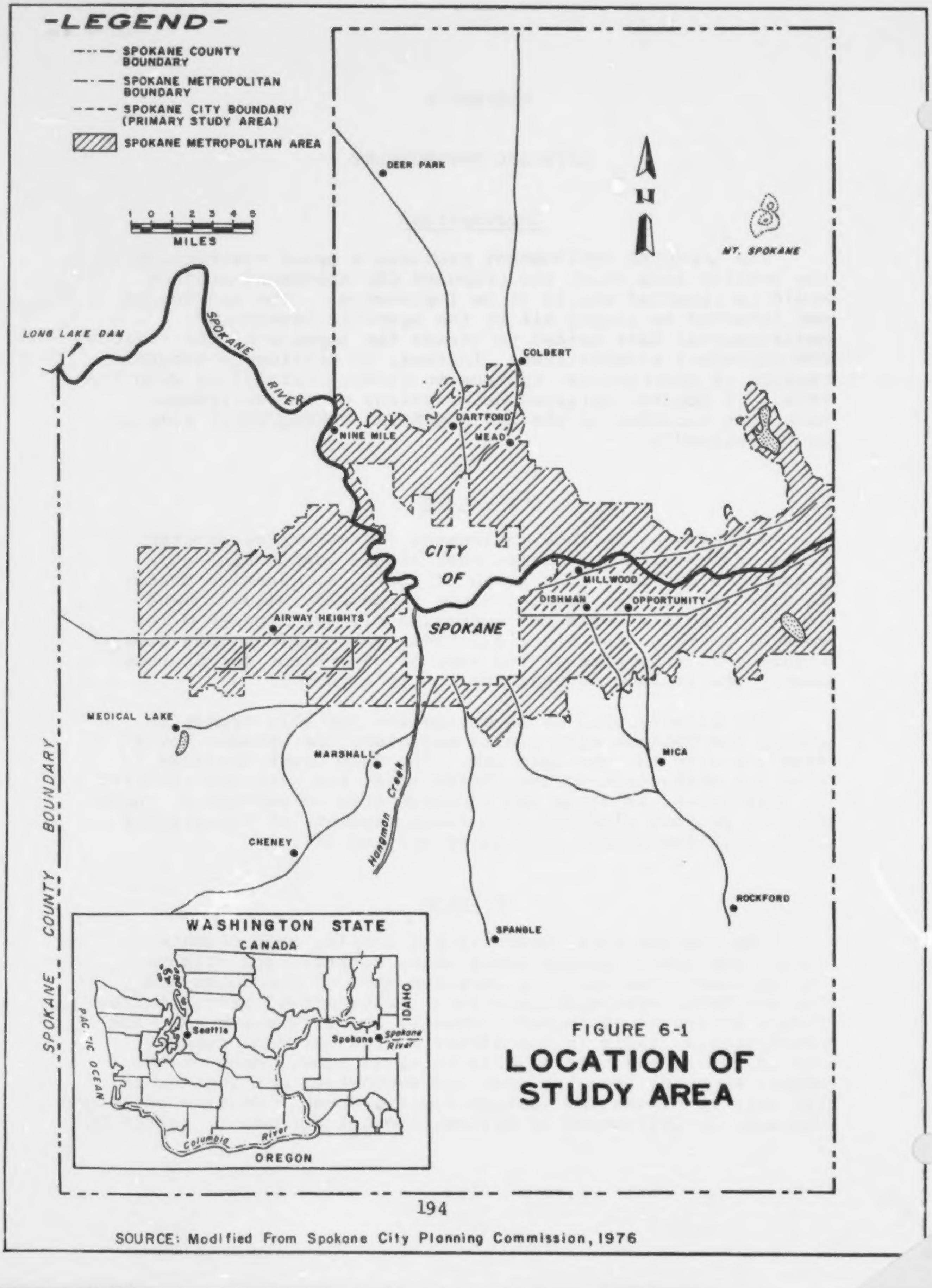

-LEGEND-
SPOKANE COUNTY BOUNDARY
SPOKANE METROPOLITAN BOUNDARY
SPOKANE CITY BOUNDARY (PRIMARY STUDY AREA)
SPOKANE METROPOLITAN AREA
1 0 1 2 3 4 5
MILES
N
DEER PARK
MT. SPOKANE
LONG LAKE DAM
SPOKANE RIVER
COLBERT
DARTFORD
MEAD
NINE MILE
CITY OF SPOKANE
MILLWOOD
DISHMAN
OPPORTUNITY
AIRWAY HEIGHTS
MEDICAL LAKE
MARSHALL
Hangman Creek
MICA
CHENEY
ROCKFORD
SPANGLE
SPOKANE COUNTY BOUNDARY
WASHINGTON STATE
CANADA
IDAHO
PACIFIC OCEAN
Seattle
Spokane
Spokane River
Columbia River
OREGON

FIGURE 6-1
LOCATION OF STUDY AREA

SOURCE: Modified From Spokane City Planning Commission, 1976 from the north or east. These intrusions result in hot, dry conditions in the summer and subzero temperatures in the winter. Summer days are normally warm and sunny with temperatures in the high 70s or low 80s, while winter days are frequently foggy or cloudy with below freezing temperatures and occasional snowfalls of several inches. The growing season extends from mid-April to mid-October (U. S. Department of Commerce, National Oceanic and Atmospheric Administration, 1976).

Seventeen years of precipitation data recorded at the City of Spokane weather station (1954-1971) show a mean monthly precipitation total in excess of 1 inch for all months of the year except July, August, and September. Even though 65 to 70 percent of the annual total usually falls in the winter months, heavy rainfalls do occur from April to June, with the highest maximum day rainfall total of 2.58 inches recorded in June (U. S. Army Corps of Engineers, 1976; Appendix E). These late spring and early summer rainfalls are as likely to produce combined sewer overflows and local basement flooding as the winter storms.

Land Resources

Topography

Spokane is located on the eastern edge of the broad Columbia Basin section of Washington. This gradually sloping volcanic plateau is bounded by the Cascade Range on the west and the Rocky Mountains on the east. The City of Spokane itself spreads across the narrow Spokane River canyon at an elevation of about 2,000 feet above sea level and rises up onto the bordering plateau land both north and south of the river at elevations up to 2,500 feet. Therefore, drainage within the city is toward the river, which bisects the city on an east-west plane. Elevations at the river drop gradually downstream to about 1,530 feet at Long Lake Dam. The surrounding terrain west of the city is dominated by the narrow river canyon, basaltic cliffs rising to 2,400 feet south of the river and river terraces and steep hills rising to over 3,400 feet north of the river. East of Spokane the river valley widens, forming a relatively flat, open plain that reaches an elevation of 2,100 feet above sea level at the Idaho-Washington border.

Geology, Seismic Features

Geologic features in the Spokane area are dominated by the multilayered basaltic flows of the Columbia Plateau south of the Spokane River and glaciated bedrock highlands to the north of the river. The city itself overlies deep glaciofluvial outwash deposits washed into the Spokane River drainage from glaciated highlands to the north and east. These deposits reach depths of 400 feet east of the city and are the waterbearing strata of the Spokane Valley-Rathdrum aquifer. At several locations within the city, basaltic material is found at or near the surface, forming Spokane Falls in the downtown area and rimrock outcrops at higher elevations in both the north and south halves of the city. Lava flows to the south and west of the city are capped by wind-blown loess deposits up to 100 feet deep. This has created an undulating topography. Downstream from Spokane, the river is bordered by a relatively narrow band of glaciofluvial material. Basaltic cliffs border the river to the south and granitic/metamorphic bedrock highlands lie to the north.

Historically there has been very little seismic activity in the Spokane area. Bedrock faulting is infrequent in the Columbia basalt plateau; the nearest faults are mapped in the Loon Lake granitic batholith to the north and mountainous uplands east of the Idaho-Washington state line (Stover, 1977). Algermissin and Perkins (1976) mapped maximum bedrock acceleration in most of eastern Washington at .04 g or less. This suggests that there is only a 10 percent chance in a 50-year period that earthquake-related bedrock acceleration would exceed 4 percent of gravity. This level of effect is controlled largely by earthquakes with magnitudes of 4.0 (Richter scale) or less.

Soils

General soil conditions in the Spokane area are best described at the soil association level. Lowlands lying along the river are covered by Garrison-Marble-Springdale association soils formed on glacial outwash deposits. They are somewhat excessively drained and excessively drained sandy and gravelly soils. The higher elevations in the southern part of the city and the rolling uplands south of the river downstream from Spokane are dominated by Hesseltine-Cheney-Uhlig association soils. These soils have been formed on the undulating basaltic outwash plain that covers most of western and southwestern Spokane County. The soils are typically well-drained and medium-textured with gravel, basalt or cobblestone substrates. A small portion of the city's northeastern fringe is underlain by shallow to deep, medium-textured Spokane-Dragoon association soils; these have formed on an acid igneous rock base (granite, gneiss, schist) rather than the more prevalent basaltic rocks in the area.

The final association found in the area is Bernhill. Bernhill soils are formed in glacial lake sediments or glacial till and are deep, medium-textured and well-drained. The only area of Bernhill soils mapped in the study area straddles the city boundary to the northwest near Five Mile Prairie (U. S. Department of Agriculture, Soil Conservation Service, 1968).

Land Uses

City of Spokane. The predominant land use in the City of Spokane is single-family residential. Residential units are distributed quite evenly throughout the city with the exception of the south side of the immediate up-river area and the central city area. The majority of residential growth since 1960 has been due to annexation of vacant lands in the northwest and southeast corners of the city. Multiple-family development has occurred primarily east of the city and in that area known as Browne's addition.

Acreage developed for multi-family use has increased at a rate greater than that for single-family use. It is anticipated that future single-family development will expand primarily in these same areas to the northwest and southeast where growth has occurred in the last decade due to the concentrations of developable vacant land. Multiple-family development is expected to continue in more centrally located areas of the city (Spokane City Plan Commission, 1974).

Business and commercial uses are primarily located in the Central Business District (CBD) and along the major arterial streets. The CBD is the intensive area of major business activity, providing a mix of retailing, services, finance, residential, government and entertainment uses. Industrial uses are primarily along the upper Spokane River, extending eastward from the city center and on the northeast edge of the city. Spokane contains extensive public parks and playgrounds which are quite evenly distributed throughout the city. Business and commercial land use is anticipated to increase to accommodate residential development. These increases are expected to occur adjacent to existing and future arterial streets. Only minor expansion of industrial land within the existing city limits is anticipated (Esvelt and Saxton, Bovay Engineers Inc., 1972). Table 6-1 summarizes existing land use in the city.

Spokane River (Idaho to Long Lake). Land adjoining the Spokane River from the Idaho stateline to the City of Spokane is used predominantly for agriculture, with some areas

Table 6-1

1978 LAND USE CITY OF SPOKANE

Land Use	Acres By Zoning Classification	Percent Of Total Land Use
Single-Family	9,957	30%
All Other Residential	1,073	3%
Group Home	132	.4%
Business/Retail and Wholesale	1,249	4%
Industry	921	3%
Parks	2,006	6%
Public/Semipublic	1,288	4%
Railroad	539	2%
Airport	236	.6%
Transportation/ Communication/Utilities	388	1%
Agricultural	425	1%
Vacant	6,465	20%
Streets	7,356	23%
Water	542	2%
Total	32,577	100%

SOURCE: Estimates by Spokane City Planning Department, 1978 remaining undeveloped (Drost and Seitz, 1978). Residential developments include Irvine, Millwood and Pasadena Park, all located just upstream from Spokane. Much of the immediate shoreline area is devoted to parks and recreation areas.

The Spokane River winds back and forth through industrial, commercial and residential areas of the City of Spokane. Recreation areas, such as the site of the 1972 World's Fair, (now Riverfront Park), have been developed along the river. Undeveloped areas occur at the downstream end of the city and include Riverside Park Cemetery, Riverside State Park, and Downriver Municipal Golf Course. The city wastewater treatment plant is located on the northern bank of the river adjacent to Riverside State Park.

Below Spokane a succession of parklands line the Spokane River. The Camp Seven Mile military reservation and the towns of Seven Mile, Nine Mile, Long Lake and Tumtum are residential pockets in this undeveloped area. Increased residential growth is indicated, however, by the expansion of the Suncrest developments near Long Lake and the rapid increase in enrollment in Nine Mile Falls School District.

Water Resources

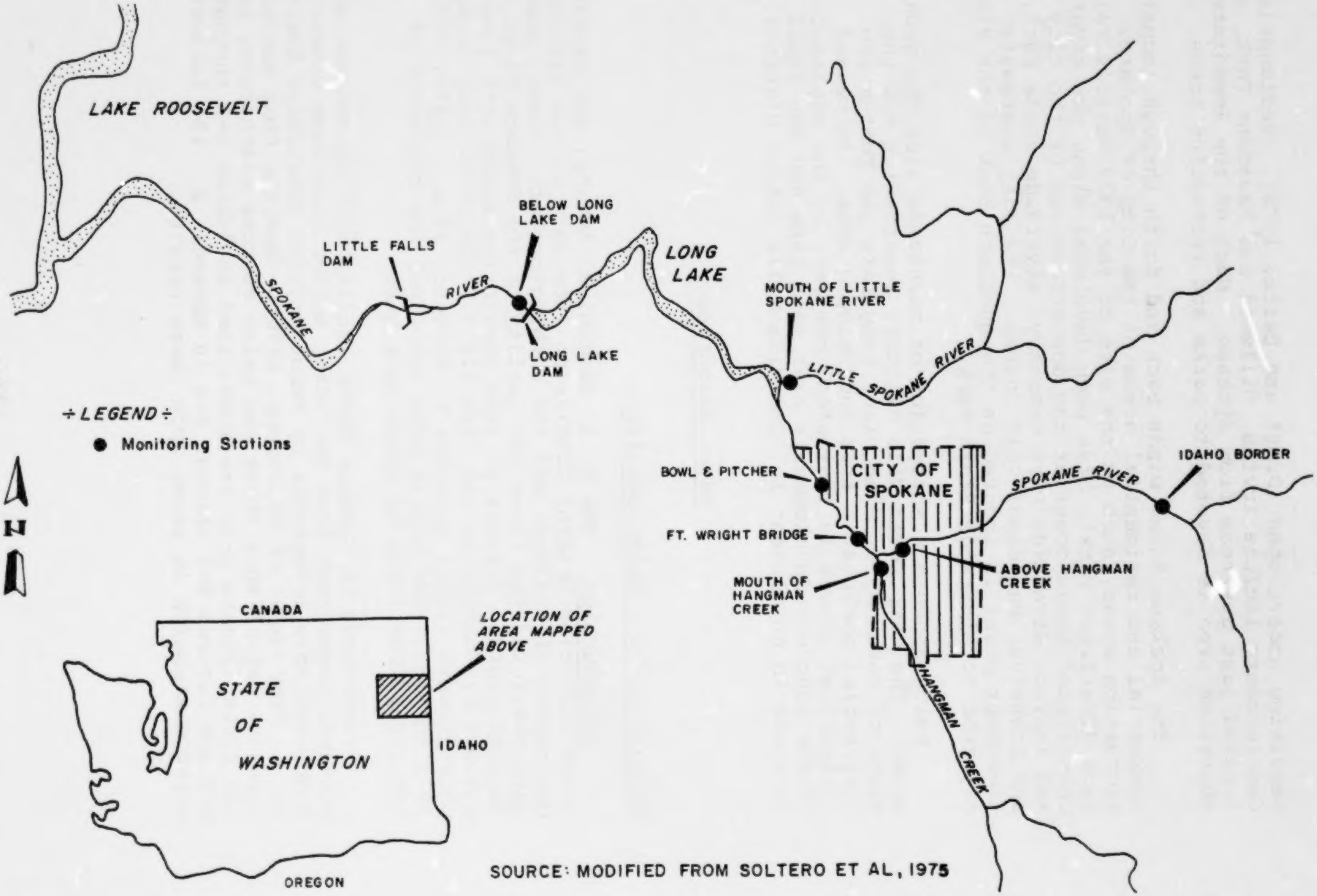
Spokane River - Water Quality

Introduction. The U. S. Geological Survey, the Washington Water Pollution Control Commission (now part of the Washington Department of Ecology) and the Washington Water Power Company have monitored the flows and quality of the Spokane River for several years. Results of this monitoring along with investigations by Cunningham and Pine (1972), the U. S. Army Corps of Engineers (1976; Appendix A) Soltero, et al. (1973, 1974, 1975 and 1976) and others have described the character of the river from Idaho to below Long Lake.

Variations in Spokane River quality with season and with distance downstream from the Idaho border have been summarized from available references by Kennedy-Tudor Consulting Engineers (U. S. Army Corps of Engineers, 1976). Results from monitoring stations established above and below sources discharging into the river (Figure 6-2) are summarized in Tables B-2 through B-9 and Figures B-1 through B-4 in Appendix B. The following brief discussion is based upon these results.

FIGURE 6-2

SPOKANE RIVER
WATER QUALITY MONITORING STATIONS


LAKE ROOSEVELT
SPOKANE
RIVER
LITTLE FALLS DAM
BELOW LONG LAKE DAM
LONG LAKE DAM
LONG LAKE
MOUTH OF LITTLE SPOKANE RIVER
LITTLE SPOKANE RIVER
CITY OF SPOKANE
BOWL & PITCHER
FT. WRIGHT BRIDGE
MOUTH OF HANGMAN CREEK
ABOVE HANGMAN CREEK
SPOKANE RIVER
IDAHO BORDER
HANGMAN CREEK
÷LEGEND÷
● Monitoring Stations
N
CANADA
STATE OF WASHINGTON
LOCATION OF AREA MAPPED ABOVE
IDAHO
OREGON

SOURCE: MODIFIED FROM SOLTERO ET AL, 1975

For this discussion, January, February and March are considered as winter; April, May and June, as spring; July, August and September, as summer; and October, November and December, as fall. Changes in the following four parameters are examined: biochemical oxygen demand (BOD), total phosphorus, total nitrogen and total coliforms. The BOD_5 is a measure of the amount of dissolved oxygen required to meet demands of aerobic bacteria in the decomposition of organic matter. Phosphorus and nitrogen have been identified as the important nutrients in the eutrophication of Long Lake (Williams, pers. comm.). Total coliforms have traditionally indicated the possible presence of pathogenic organisms.

Idaho Border to Fort Wright Bridge. Comparing water quality measured in the Spokane River at the Idaho stateline with that at Fort Wright Bridge helps demonstrate the impacts of industrial dischargers, Spokane's combined sewer overflows and Hangman Creek flows.

During winter and spring, BOD_5 decreased from the stateline to Fort Wright Bridge although data were limited to less than 5 measurements; summer and fall measurements show little change downstream (Figure B-1).

Phosphorus levels were higher at the downstream station throughout the year. The significant increase during winter (Figure B-2) may reflect a phosphorus loading from Hangman Creek, CSO's, and/or surface runoff, although small sample size (less than 5 data points) provides little support for interpretation.

Total nitrogen concentrations were also higher at Fort Wright Bridge, except during summer (Figure B-3). Nitrogen influx via Hangman Creek or CSO's may account for the jump in nitrogen levels in the Spokane River during winter. More measurements would help confirm this.

Sampling for total coliforms was done only during spring and summer at these two stations. Sparse spring measurements place coliform levels well above Class A standards (Figure B-4). Overflows from Spokane's combined sewer system are the probable cause of these high levels during this stormy season. In summer, higher coliform concentrations are found below Coeur D'Alene than below Spokane. Chlorine discharged from the sewage treatment plant may be partly responsible for these lower summer concentrations.

Fort Wright Bridge to Bowl and Pitcher Park. Water quality differences between the Spokane River at Fort Wright Bridge and Bowl and Pitcher Park reflect the impact of discharges from Spokane's sewage treatment plant. The following analysis is based on data collected before the new advanced wastewater treatment system was constructed. A significant reduction in phosphorus loading is expected from the new facilities.

BOD concentrations at Bowl and Pitcher Park were higher (by 1 to 2 mg/l) than upstream levels throughout the year (Figure B-1). The Spokane sewage treatment plant is a likely source for the organic materials exerting demands on river oxygen.

Before tertiary treatment, summer and fall phosphorus levels increased significantly below the treatment plant (Figure B-2). Winter and spring runoff may have diluted the phosphorus loadings. Lack of data (less than 5 data points) collected during spring, summer and fall, makes trends less certain. Soltero, et al., (1976) have found comparable results. Mean orthophosphate concentration at Seven Mile Bridge (below Bowl and Pitcher) was 13 times greater than that determined for Fort Wright Bridge during 1975.

At Bowl and Pitcher, total nitrogen levels were higher during fall than at Fort Wright Bridge (Figure B-3). Winter levels were comparably high at both stations. Sewage treatment plant effluent is again suspected. The few spring measurements taken show little change between stations; no summer data were given. Mean inorganic nitrogen at Seven Mile Bridge increased 4 times over that at Fort Wright Bridge in 1975 (Soltero, et al., 1976).

Spring overflows from the city and its treatment plant may account for a continued rise in total coliform concentrations during the season (Figure B-4). Fewer than 5 data points establish this spring increase and a marked decrease in summer concentrations. The difference in spring concentrations can be accounted for in measurement accuracy alone. Summer decreases may be explained by releases of chlorine from the sewage treatment plant at levels lethal to most bacteria.

Bowl and Pitcher to Long Lake. The Little Spokane River and the change from a river to a lake environment account for most of the difference in water quality between Bowl and Pitcher and Long Lake measurements. Surface water samples taken during summers are the only data summarized by the U. S. Corps of Engineers (1976; Appendix A).

BOD concentrations, measured fewer than five times, were lower at Long Lake than at Bowl and Pitcher (Figure B-1). Samples taken from a depth of 24 m had higher BOD concentrations, suggesting that the organic materials may have settled.

Summer phosphorus levels at Long Lake indicate that the lake acts as a phosphorus sink (Figure B-2). Studies by Soltero et al., (1976) corroborate this hypothesis. Their results indicate that nitrogen may also be entrapped within the reservoir.

Total coliform counts (based on fewer than 5 samples) were higher at Long Lake than at Bowl and Pitcher. Whether these coliforms came from city overflows, the little Spokane River, or other natural runoff is unknown. Regrowth of chlorine-resistant bacteria could also explain these higher counts.

Long Lake to Below Long Lake Dam. The quality of water released from Long Lake Dam is the product of lake processes. The water quality is discussed here in terms of what was entrapped by Long Lake and what continues downstream.

Results of very limited BOD sampling during summers show that concentrations remain low downstream as they do in the lake surface waters (Figure B-1).

Summer and fall total phosphate phosphorus concentrations below Long Lake were significantly less than those measured at Bowl and Pitcher Park (Figure B-2). These results are consistent with the phosphorus entrapment within Long Lake described by Soltero, et al., (1976). During winter and spring, phosphorus concentrations were low at both stations.

Total nitrogen levels below Long Lake decreased from or remained approximately equal to those recorded at Bowl and Pitcher for every season except summer, when an increase was noted (Figure B-3). Lack of information about the predominant forms of nitrogen accounting for this increase precludes description of causal mechanisms. Soltero, et al., (1976) found nearly the same total nitrogen load leaving Long Lake (16.42 metric tons per day) as were entering (16.89 metric tons per day) during the 1975 sampling period.

Total coliform concentrations, although less than those found at some upstream stations, exceeded limits recommended for Class A streams during all seasons (Figure B-4).

Spokane River - Beneficial Uses

The high quality of Spokane River water above the City of Spokane lends itself well to all forms of water contact recreation. Visitors enjoy swimming, boating, trout fishing and just taking in the beauty of the river and its environs.

The river is put to more practical uses nearer the city. Several dams have been constructed to generate electricity. Water is also essential in many of the local industrial processes. Aesthetic enjoyment is still provided by white water crashing down Spokane Falls, past Riverfront Park, and on into the gorge leading out of the city.

Below the city, the Spokane River again becomes the focus of water-oriented recreation. Riverside State Park, and Long Lake are visited by swimmers, water-skiers, rafters, fisherman, hunters and those who seek the restful pleasure that the view of a beautiful river can provide.

Other Surface Waters

Hangman Creek. Flows in Hangman Creek range from a trickle (less than 1 cfs) during late October 1975 to as much as 650 cfs in mid-May (Soltero, et al., 1976). During storms a brown, sediment-laden plume often extends from the creek's mouth into the Spokane River. Nevertheless, flows are small enough during most of the year to prevent this nutrient-rich (see Table B-4) stream from significantly influencing Spokane River quality.

Beneficial uses of Hangman Creek are principally agricultural with some minor aesthetic value. The mouth of the creek, with its warm water and sandy beaches, serves as a haven for sun bathers.

Little Spokane River. Flows in the Little Spokane River are more substantial but much less extreme than Hangman Creek. Average flows during 1975 ranged from approximately 170 cfs to 970 cfs (Soltero, et al., 1976).

Water quality within the Little Spokane River is influenced by discharges from the Spokane Valley groundwater aquifer (Table B-7). The river has relatively low phosphorus, ammonia and zinc, but has high total nitrogen concentrations and is generally nutrient rich. Coliform levels can be high in this tributary (U. S. Army Corps of Engineers, 1976; Appendix A). Because the Spokane River resembles a lake at the confluence of the Little Spokane, it is difficult to assess the tributary's effect on the system separate from this change in river character.

The Little Spokane River is an important agricultural water supply. Spokane County owns 181 acres of park land adjacent to the Little Spokane, but most of the waterfront lands are privately owned (U. S. Army Corps of Engineers, 1976; Appendix E).

Groundwater Quality/Quantity, Water Supply

Groundwater. Recent reports by the U. S. Army Corps of Engineers (1976) and by Drost and Seitz (1978) provide detailed descriptions of the Spokane Valley - Rathdrum Prairie aquifer, which underlies portions of both Washington and Idaho, including the Spokane study area. A brief overview of this aquifer follows.

The Spokane Valley - Rathdrum Prairie aquifer consists of unconsolidated quaternary glaciofluvial deposits underlying an area of about 350 square miles. Groundwater moves through some areas at velocities exceeding 60 feet per day. Generally the water table is between 40 and 400 feet below the land surface, and it fluctuates 5 to 10 feet annually. The aquifer is recharged and discharges at an average rate of about 1,320 cubic feet per second.

Water quality within the aquifer is generally good. Of the 3,300 analyses reviewed by Drost and Seitz (1978), less than 0.5 percent revealed contaminant levels exceeding levels specified in the National Interim Primary (or proposed secondary) Drinking Water Regulations (U. S. Environmental Protection Agency, 1975) for constituents possibly hazardous to health. About 1.4 percent of 6,300 analyses for constituents considered detrimental to the aesthetic quality of water exceeded the recommended levels. The contaminants that did occasionally exceed standards are shown on Plate 10 of Drost and Seitz (1978).

Water Supply. Water users within the study area (from the Idaho border to the Little Spokane River rely almost entirely upon the Spokane Valley aquifer. Approximately 125 purveyors and users with individual supplies (not counting individual dwellings or farms with their own supply) tap this groundwater source.

The total amount of water used in the study area, excluding the water Kaiser Trentwood passes once through its cooling towers, is presented according to class of use in Table 6-2 below.

Table 6-2
WATER USE IN STUDY AREA

Class of Use	Total Annual Use (acre-feet)
Domestic	96,740
Industrial	24,580
Agricultural irrigation	35,960
Nonagricultural Irrigation	1,600
Total	158,880

SOURCE: U. S. Army Corps of Engineers, 1976; Appendix C

Surface water use is limited mainly to nonconsumptive uses such as hydroelectric power generation, maintenance of fishery resources and recreation.

Flooding

The U. S. Army Corps of Engineers Metropolitan Spokane Study (U. S. Army Corps of Engineers, 1976, Technical Report) identified four areas within the city that have periodic flooding problems. Those areas on the Spokane River are Peaceful Valley near the Maple Street Bridge, Riverpoint near the Trent Avenue Bridge, and Upriver Drive between Granite and Smith Streets. On Hangman Creek, flooding problems extend from the 11th Avenue Bridge upstream to the city limits. The table below lists the areas subject to damages from the 100-year flood as identified at the time of the Corps report.

Table 6-3

FLOOD HAZARD AREAS

Location	Structure Involved	Developed Area Involved, Acres	Maximum Depth, Ft.
Peaceful Valley	20 residences, 1 industry	11.7	4
Riverpoint	4 industrial/1 post office	8.0	3
Upriver Drive	2 apartments, 1 residence	-	4
Hangman Creek	Up to 5 residences and farm buildings, a trailer court	-	-

The City of Spokane, in cooperation with the Army Corps of Engineers, is now in the process of preparing more detailed mapping of flood hazard areas. This is being done as part of the National Flood Insurance Program, administered by the U. S. Department of Housing and Urban Development, so that local flood insurance rates can be established. When completed, the mapping will include flood hazard areas along the Spokane River and Hangman Creek, and also local flooding and drainage problem areas away from the river in the small drainage basins that feed into the river.

Biological Resources

Terrestrial Flora and Fauna

The flora and fauna along the Spokane River extending from the Idaho border to its confluence with the Columbia

River are discussed briefly below. For a more thorough discussion and lists of plants and animals found near the river and in open space areas within the City of Spokane, refer to reports by the U. S. Department of Army, Corps of Engineers (1976; Appendix E) and the Spokane City Plan Commission (1976), respectively.

Flora. Vegetation along the Spokane River within the study area can be considered as three distinct stretches, i.e., mouth to Nine Mile Falls, Nine Mile Falls to Spokane and Spokane to the Idaho border (U. S. Department of Army, Corps of Engineers, 1976).

The stretch of the Spokane River from its mouth to Nine Mile Falls is characterized by stands of ponderosa pine alternating with grass and steppe vegetation. Grass and steppe species of perennial forbs and annuals are the understory of the pine stands, with bitterbrush dominating the shrub layer. This area has been logged extensively in the past and timber harvests continue. Some timbered areas have been replaced by orchards.

Between Nine Mile Falls and Spokane, stands of ponderosa pine up to 150 years old can be found. Thin soils favor a blue bunch wheatgrass understory. Douglas fir is found occasionally on pockets of silty loam soils.

For many years, the area along the Spokane River east of the city and extending to the Idaho border has been cleared for agriculture. With this agricultural clearing and the current conversion to urban development, few stands of ponderosa pine remain.

Fauna. Mule deer, white-tail deer and bear are the principal big game species of the Spokane River area. Mule deer frequent the open western ranges. The white-tail deer, which are part of the Coeur d'Alene herd, are restricted to lower elevations by their mule deer competitors. Bear occur throughout the Spokane River area.

Fur bearers such as muskrat, mink, beaver, racoon, otter, and bobcat are found within the Spokane River watershed. Muskrat, mink, beaver and racoon are relatively abundant and occur throughout the area; otter and bobcat are rare within the area.

Greater food supply and better weather caused a westward shift of the migratory path of waterfowl away from Spokane. Long Lake is a principal resting place for the remaining 10 percent of the former migratory population. Mallards and Canada geese are the most common waterfowl of the Spokane area.

Ruffed grouse are the most abundant members of the upland game bird population within the Spokane region. Ring-necked pheasant and Hungarian partridge populations have been reduced and restricted by the conversion of suitable habitat to agricultural purposes. Concentrations of California quail can be found near the Spokane River.

Fifty-six observers participating in the 1977 Audubon Christmas bird count for the Spokane area reported 78 species of birds (about 10,699 individuals) (Heilbrun, 1977). Of the waterfowl, raptors, perching birds, etc. sighted, two endangered species were noted. The northern bald eagle and merlin are considered endangered by the Washington State Department of Game (Saletti, pers. comm.).

Aquatic Flora and Fauna

Flora. The phytoplankton of Long Lake have been the object of careful study since the early 1970's. During 1975, 41 genera and 45 species of phytoplankton were identified in samples collected from the lake's euphotic zone. Noxious blooms of the alga *Anabaena flos-aquae* have occurred in the lake.

The rooted aquatic macrophyte yellow floating heart (*Nymphoides peltatum*) fills the quiet backwaters of Long Lake during the spring and summer.

Fauna. The fishery resources of the Spokane River from its mouth to the Idaho border are reviewed in Appendix E of the Water Resource Study prepared by Kennedy-Tudor Consulting Engineers for the U. S. Army Corps of Engineers (1976). Table 6-4 is extracted from Table 1 in Section 315.51 of the Corps report.

Unique Environmental Features

The Washington State Department of Game maintains a *Current Survey Listing and Ratings of Unique Environmental Features*. This listing describes areas of Spokane County outside the City of Spokane. The lower Little Spokane River ecosystem, the Spokane River ecosystem (downstream from the Hangman Creek and upstream from Millwood) and the Long Lake ecosystem are ranked among the top ten unique features within Spokane County. These features, along with the Hangman Creek ecosystem (ranked 16th), are within the current study area.

Table 6-4

SUMMARY OF FISH SPECIES OCCURRENCE FROM LONG LAKE TO THE IDAHO BORDER

Location	Species
Spokane River in Long Lake Reservoir	Perch, black and yellow bullhead, large mouth bass, crappies, bluegill, pumpkinseed, green sunfish, carp, tench, chisle mouth, peamouth, chubs
Spokane River, Bowl and Pitcher to Falls	Brown trout
Spokane River, Millwood to Idaho Line	Rainbow trout
Little Spokane River, mouth to branches	Carp, squawfish, bridgelip suckers
Hangman Creek mouth to Tensed	Speckled dace, chislemouth, redside shiner, squawfish, bridgelip suckers, longscale suckers, torrant sculpin, brown bullhead

SOURCE: U. S. Army Corps of Engineers, 1976; Appendix E.

Aesthetics

The major view sites in Spokane are generally associated with the steep sloping valley walls of the Spokane River and Hangman Creek. The downriver environment is characterized by fast water, steep bluffs and undisturbed flora and fauna. Portions remain in a natural state with basalt rimrock cliffs and narrow valleys.

The upriver environment is that of pastoral stream with shallow banks and some urban development. Industrial and commercial development reduce aesthetic values in the segment. The central river environment is typified by falls, rapids, and an intensive urban fringe. Riverfront Park is a major aesthetic attraction in the central portion. Hangman Creek retains a rural open space setting with its meandering creek through agricultural lands. Other scenic qualities within the city are associated with the many parks, the attractive residential neighborhoods, and the architectural interest of the older homes and commercial and public buildings in the central area. Major views and vistas identified in a recent environmental inventory include the large west Spokane open space in areas such as Indian Canyon, Palisades Park, High Drive Parkway, High Bridge Park, Summit Boulevard, Downriver Park, and Bowl and Pitcher; the area around Glover Field and Washington Water Power Dam, Upriver Drive, Minnehaha Park, and Lincoln Park (Spokane City Plan Commission, 1976a).

Social Environment

Population

After a period of very rapid population growth in Spokane between 1900 to 1910, population increased very slowly until the boom period kindled by World War II and the creation of nearby military bases. Growth continued through the 1950's and then began a numerical decline in the period 1960 to 1970. The population has shown a very modest increase in the current decade and this is expected to continue in the future. The northwest and northeastern portions of Spokane are currently the most heavily populated, with the greatest population density in the central area of the city. Substantial population growth is anticipated in both the northwest and southeast portions of the city (Spokane City Plan Commission, 1975). The city is expected to decline as a percent of the county population, while the county is expected to increase slightly as a percent of the state population. The officially adopted mean population forecast to the year 2000 for the City and County of Spokane is shown in Table 6-5.

Table 6-5

CURRENT AND PROJECTED POPULATION
CITY AND COUNTY OF SPOKANE

	1970	1977	1980	1985	1990	1995	2000
City of Spokane	170,516	174,500	182,000	188,000	194,700	200,400	205,800
% Increase		2.3	6.7	3.3	3.6	2.9	2.7
County of Spokane	287,487	299,000	318,000	334,000	338,000	352,000	386,000
% Increase		4.0	6.3	5.0	5.4	4.1	4.6

SOURCE: Projection by Spokane City Plan Commission (1975).

The mean age of the population has been steadily declining in both the city and county as shown in Table 6-6. Due to the declining birth rates since the 1960 decade, the age of the population is expected to increase over the next decades. In 1970, an estimated 14 percent of the city population was 65 years and over.

Table 6-6

MEAN AGE OF POPULATION

Year	Spokane	Spokane County
1960	31.6	29.6
1970	30.4	28.06
2000 est.	33.98	33.29

SOURCE: City Plan Commission Estimates, 1974

In 1970 there were an estimated 2.82 persons per household, and this number is expected to decrease in the future.

According to the 1970 Federal Census, males constituted 47 percent of the population and females 53 percent of the total population. Minorities constitute 3 percent of the total population with Blacks representing the largest minority group.

Per capita effective buying income (all income minus taxes) in 1976 was estimated at $4,504 (below the United States average of $5,003) while household income was estimated at $13,774 (above the United States average of $12,824; Sales Management, 1977). The higher income areas are to the southeast and northwest, where a great deal of the newer housing has been constructed. The 1970 U. S. Census indicated that 18.4 percent of the population had incomes less than the poverty level. The lowest income areas include the east side of the CBD and the Peaceful Valley section. These areas have a high number of elderly and disabled persons who live on fixed incomes. Black families have the lowest median family income in the city.

Regional and Local Economies

Spokane is the economic and major distributing center for the 36-County Inland Empire which encompasses eastern

Washington, northern Idaho, and western Montana. A portion of Canada is also within the Spokane trade area. The Spokane economy has a diversified base and has shown particularly strong growth in recent years. The central area of Spokane serves as the business, financial, and retail center for the city, as well as the Inland Empire. EXPO "74" provided tremendous economic stimulus to the downtown area and resulted in a major renewal and building expansion program. Due largely to EXPO "74", Spokane has become a popular visitor-convention center with estimated 1978 revenue of $16.3 million (Spokane Area Development Council, 1978). In July 1976, there were 2,563 employee units dealing in services and 3,261 in trade with a combined annual payroll of about $354,500,000 within Spokane County (Spokane Area Development Council, 1976).

As shown in Table 6-7, total retail sales and employment show rapid growth in both the city and county, with the greatest increases occurring in the newer trade areas in the county's outlying urbanizing areas.

Spokane also experiences a significant impact from its manufacturing base. Industries not based on the area's natural resources have shown the strongest growth potential. Among the resource based industries, primary metal production is the largest employer with 4,300 currently. Food and kindred products manufacturing has remained about constant throughout the 1970's, with lumber and wood products showing a decline. The manufacturing of machinery and fabricated metal products has shown steady increases. Multinational corporations with Spokane branches are primarily service and trade industries with the major exceptions of Kaiser Aluminum and Chemical Corp. The estimated 433 manufacturing employers in the county showed a gross income of $594 million in 1976 and a gross payroll of $162.1 million in 1975 (Spokane Area Development Council, 1977a).

Employment in contract construction has remained very strong since 1975 due to consistent residential, commercial, and industrial construction demand. Overall unemployment has decreased dramatically from the 8.1 percent in 1977 to an estimated 6.1 percent in February 1978 (Spokane Area Development Council, 1978a). Employment statistics are shown in Table 6-8.

Crab Creek Area

Crab Creek is an extremely long stream with its headwaters in the rolling Columbia plateau scablands 25 miles west of Spokane and its mouth into the Columbia River near

Table 6-7

TAXABLE RETAIL SALES
1974 - 1977

Year	Spokane City	Prior Year	Spokane County	Prior Year
1974	$992,556,520	+20.0	$1,358,429,924	+25.0
1975	993,242,854	+.07	1,348,200,306	-.75
1976	1,091,827,619	+9.9	1,522,653,564	+12.9
1977	1,288,456,302	+18.0	1,835,745,798	+20.6

SOURCE: Spokane Area Development Council, 1977.

Table 6-8

LABOR FORCE (ANNUAL AVERAGE) EMPLOYMENT AND UNEMPLOYMENT SPOKANE COUNTY (IN THOUSANDS)

INDUSTRY	1977	1976	1975	1974	1973	1972	1971
Civilian Labor Force	131.2	130.8	122.9	129.9	123.4	118.0	115.
Workers in Labor-Management Disputes[1]		.0	.0	.1	.1	.0	.0
Unemployment[2]	10.6	10.2	11.8	10.5	8.5	8.4	7.8
Percent of Labor Force[2]	8.1	7.8	9.6	8.1	6.9	7.1	6.8
Employment	120.6	120.7	111.1	119.4	114.9	109.6	107.2
Agricultural					2.4[3]		2.4
Nonagricultural					111.2[3]		103.6
Employer, own account Unpaid & domestic					12.8[3]		12.2
Wage & Salary Workers - Nonag.	111.9	108.2	101.6	104.8	98.3	94.7	91.4
Manufacturing	15.5	14.6	13.3	14.4	14.1	12.8	12.3
Food and Kindred Products	1.8	1.7	1.7	1.7	1.6	1.7	1.8
Lumber & Wood Products (except furniture)	1.2	1.1	1.0	1.1	1.2	1.1	1.0
Primary Metal Industries	3.9	4.0	3.5	4.1	3.8	3.5	3.5
Fab. Metal Prod. & Mach.	3.0	2.6	2.2	2.2	2.0	1.6	1.5
Other Manufacturing	5.6	5.2	4.9	5.3	5.5	4.9	4.5
Nonmanufacturing	96.4	93.6	88.3	90.4	84.2	81.9	79.1
Contract Construction	5.9	5.9	5.1	5.4	5.8	5.5	4.8
Transp. Comm. & Utilities	7.5	7.3	7.2	7.7	7.5	7.4	7.3
Wholesale & Retail Trade	31.2	30.0	28.0	28.6	26.2	25.1	23.9
Finance, Insurance & Real Estate	7.2	6.9	6.1	6.0	5.9	5.6	5.5
Services	24.7	23.8	22.5	23.5	20.4	19.8	19.1
Government	19.5	19.3	19.0	18.8	18.1	18.2	18.2
Mining & Forestry	.4	.4	.4	.4	.3	.3	.3

1. Preliminary
2. Figures prior to 1972 are not strictly comparable with later figures because of a methodology change.
3. Estimates

Source: Washington Employment Security Department the Wanapum Dam over 160 miles southwest of Spokane (Figure 4-5). The portion of the creek studied in this report includes the upper reaches from the headwaters to the area around Odessa and Wilson Creek. This stretch of the creek wanders through rolling agricultural lands used primarily for growing wheat and pasturing beef cattle. Flows in the creek through this stretch are relatively small, but subject to considerable fluctuation. The stream is perennial in its headwaters where flows are not monitored. In the vicinity of Odessa, Crab Creek often dries up, flowing only in the subsurface during late summer and fall. The U. S, Geological Survey gauging station at Irby has recorded annual average flows of 79 cfs.

The Washington Department of Ecology has classified Crab Creek as a Class B stream. This indicates that it should be of sufficient quality to support most beneficial uses except domestic water supply and body contact recreation. Currently its uses include stock watering, minor amounts of crop irrigation and occasional recreation (primarily fishing, aesthetic enjoyment). The stream's quality has been infrequently monitored, but is generally quite good with total dissolved solids averaging about 230 mg/l and dissolved oxygen levels averaging around 11 mg/l (Stevens, Thompson and Runyan, Inc., 1975).

As mentioned above, land use in the Crab Creek drainage is primarily agricultural. Land immediately adjacent to the stream is typically used for rangeland, while the rolling hills back from the stream are dry farmed for wheat. Scattered acreages of irrigated crops are found in the basin, especially around Odessa and Wilson Creek. The creek flows through both Odessa and Wilson Creek, causing periodic flood damage in these small communities.

Air Quality

Because of its topographical and geographical orientation, the metropolitan Spokane area is frequently subject to stable atmospheric conditions. These stable atmospheric conditions lead to poor ventilation and subsequently poor dispersion of air-borne pollutants. Because of both poor dispersion of pollutants and significant human activities, ambient concentrations of suspended particulates, carbon monoxide, and photochemical oxidants exceed Washington and federal standards in certain areas of Spokane County. Due to the low frequency of violations of the standard, photochemical oxidants are not considered to be a major problem. Suspended particulates and carbon monoxide, however, are a significant problem.

Under provisions of the National Clean Air Act, areas exceeding the national standards after July 1976 were designated nonattainment areas, and those so-designated areas must develop a comprehensive plan to meet standards by 1982 (an extension to 1987 is possible under certain circumstances). A study to better define Spokane's air quality problem was initiated jointly by the State of Washington Department of Ecology (DOE) and the Spokane County Air Pollution Authority (SCAPCA). On the local level, the city and county will individually identify, analyze the effects, and select the strategies for implementation into a plan to meet federal standards. These plans will be submitted to the Spokane Regional Planning Conference (SRPC). Subsequently, joint SRPC-DOE public hearings will be conducted to review, revise and adopt an air quality plan.

The largest single source of suspended particulates is unpaved roads (SCAPCA, 1977). As part of the strategies to meet federal standards, city and county officials have initiated a program to pave dirt roads and parking lots. Road oil will also be used on unpaved commercial storage areas to mitigate the suspended particulate problem.

Automobiles account for over 90 percent of carbon monoxide emissions in Spokane County (SCAPCA, 1977). The federal standard for carbon monoxide is consistently exceeded within the Spokane central business district and along north Monroe and north Division Streets. The carbon monoxide problem is clearly within the city limits. Despite the addition of emission control devices on new automobiles, no discernible decrease in ambient carbon monoxide concentrations has occurred in the last 6 years (SCAPCA, 1977). Increasing vehicle traffic and congestion is apparently offsetting any decrease in emissions due to control devices on new automobiles. Numerous strategies, including improved public transportation and new bicycle trails, have been initiated by city and county officials to meet the 1982 deadline for attaining federal standards.

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Dunmire, W. July 31, 1978. Superintendent of the Coulee Dam National Recreation Area, Coulee Dam, WA.

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McCalgen, J. August 30, 1978. Warden for Spokane area, Wash. State Dept. of Game.

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APPENDIX A

CONSTRUCTION IMPACTS SUMMARY TABLES

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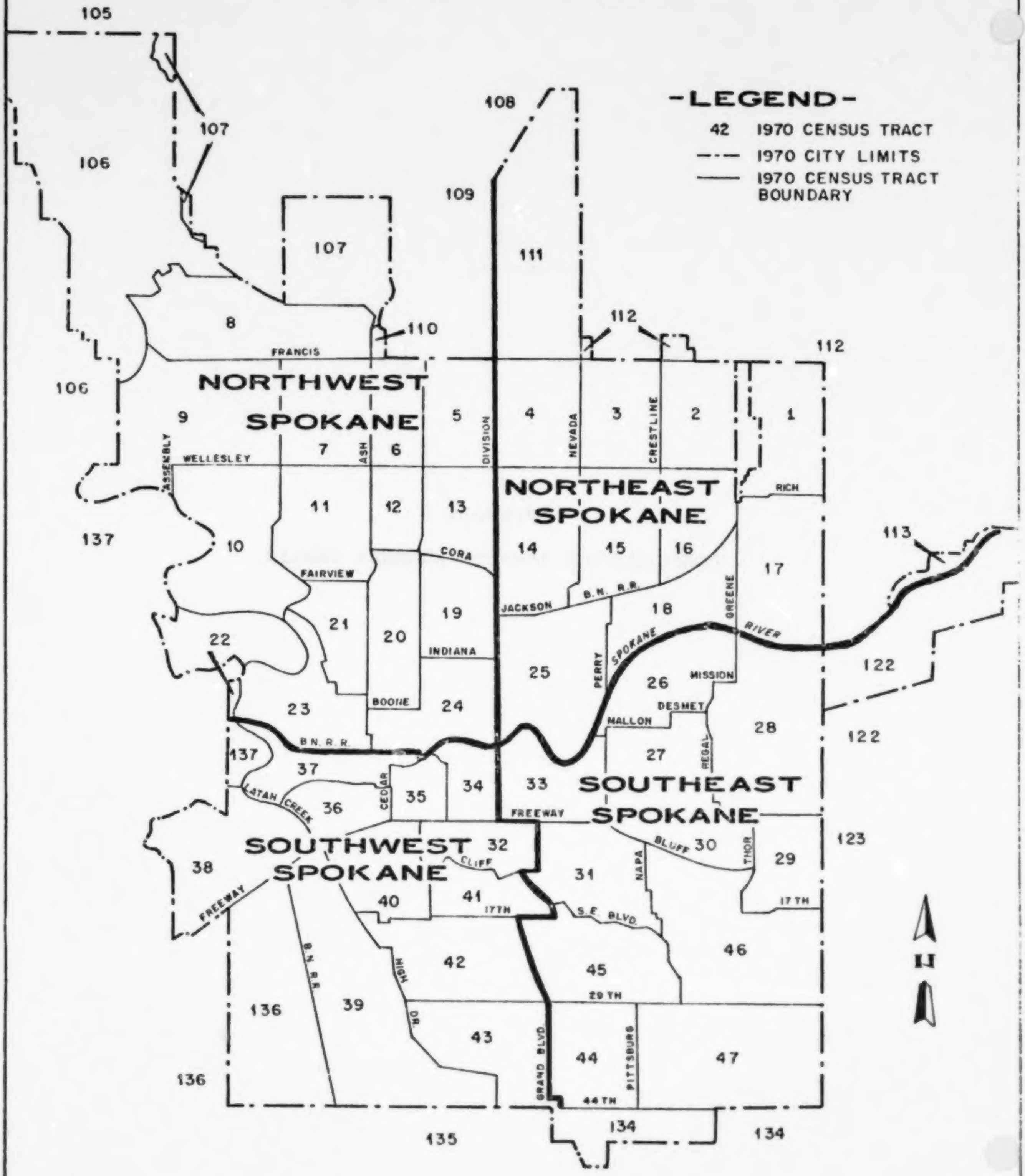
FIGURE A-1

SPOKANE, WASHINGTON CENSUS TRACTS


-LEGEND-
42 1970 CENSUS TRACT
-·- 1970 CITY LIMITS
— 1970 CENSUS TRACT BOUNDARY
NORTHWEST SPOKANE
NORTHEAST SPOKANE
SOUTHEAST SPOKANE
SOUTHWEST SPOKANE
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FRANCIS
WELLESLEY
ASSEMBLY
ASH
DIVISION
NEVADA
CRESTLINE
RICH
CORA
FAIRVIEW
JACKSON
B.N. R.R.
GREENE
SPOKANE RIVER
INDIANA
BOONE
PERRY
MISSION
DESMET
MALLON
REGAL
LATAH CREEK
CEDAR
FREEWAY
CLIFF
BLUFF
THOR
NAPA
17TH
S.E. BLVD.
HIGH DR.
29 TH
GRAND BLVD.
PITTSBURG
44 TH
N

Table A-1

ALTERNATIVE 1 CONSTRUCTION ACTIVITY
RESIDENTIAL IMPACT SUMMARY

Census Tract (CT)*	Housing Types Single-Family	 2 or More Units in Structure	Severity of Impacts
Northwest Spokane			
9	X		Significant
7	X		Significant
6	X		Minor
5		X	Minor
10	X		Significant
	(Storage Basin Sites 13B and 14B)		
11	X	X	Significant
12	X	X	Minor
13	X	X	Minor
10	X		Moderate
11	X		Minor
12	X	X	Minor
13	X	X	Moderate
21		X	Minor
19	X	X	Minor
23	X	X	Minor
24	X		Minor
Northeast Spokane			
4	X	X	Significant
3	X	X	Minor
2	X	X	Significant
14	X	X	Significant
15	X	X	Significant
16	X	X	Moderate
17	X		Significant
	(Storage Basin Site 2B)		
18	X	X	Moderate
Southwest Spokane			
37	X	X	Significant
	(Storage Basin Site 8B)		
35		X	Minor
40	X	X	Moderate
32	X	X	Minor
41	X	X	Moderate
42	X	X	Significant
43	X		Moderate
Southeast Spokane			
26	X	X	Significant
		(Storage Basin Site 3B)	
28		X	Minor
31	X	X	Significant
30	X	X	Moderate
29	X		Moderate
45	X	X	Significant
46	X	X	Moderate
44	X		Minor
47	X	X	Moderate

*Only those census tracts with impacts are listed in this and following tables.

Table A-2

ALTERNATIVE 1 CONSTRUCTION ACTIVITY
COMMERCIAL IMPACT SUMMARY

CT	Commercial Type	Location	Severity of Impact
		Northwest Spokane	
9	LB[1]	Driscoll and Rowen	Minor
7	LB	Alberta and Rowen	Moderate
7	LB	Ash and Wellesley	Moderate
6	LB	Ash and Rowen	Moderate
5	CB[2]	Division	Significant
10	Tourist	Downriver Clubhouse	Significant
11	CB	Alberta and Wellesley (Shadle Center)	Significant
11	LB	Oak and Garland	Moderate
13	CB	Post and Garland to Howard and Garland	Significant
13	CB	Division	Significant
19	CB	Division	Significant
		Northeast Spokane	
4	CB	Division	Significant
14	CB	Division	Significant
14	LB	Nevada and Wellesley	Moderate
14	LB	Nevada and Kiernen	Moderate
14	LB	Nevada and Bridgeport	Moderate
16	LB	Crestline and Bridgeport	Moderate
		Southwest Spokane	
35 & 34 (Central Business District-CBD)	CI[3]	Cedar	Moderate
	CI	2nd	Moderate
	CI	Division	Moderate
40	LB	Maple and 10th	Moderate
41	LB	Grand and 13th	Moderate
		Southeast Spokane	
33	CI	2nd	Moderate
27	CB	Sprague and Crestline	Moderate
28	CB	Havana and Sprague (Eastown Center)	Significant
122	CI	Surro and South Riverton (Storage Basin 1B)	
30	LB	Altamont 5th	Moderate
45	LB	Grand-16th thru 18th	Moderate
44	CB	Grand and 31st (Manito Center)	Moderate

Footnotes:

[1] LB - Local Business - smaller neighborhood shopping facilities consisting of retail and service establishments.

[2] CB - Community Business - varied retail, service, and office establishments serving wide selection of goods to several neighborhoods.

[3] CI - Commercial Zone - variety of businesses, warehouses, and light industrial uses in commercial park developments.

[4] CBD - Central Business District/Zone - stores, offices, service establishments, hotels, government and cultural centers at central focal point of city's arterials

Table A-3

ALTERNATIVE 1 CONSTRUCTION ACTIVITY
INDUSTRIAL IMPACT SUMMARY

CT	Industrial Type	Location	Severity of Impacts
		Northwest Spokane	
No known impacts in northwest Spokane.			
		Northeast Spokane	
14	LI[1]	Nevada and Jackson	Moderate
16	LI	Regal and Garland	Moderate
18	LI	Crestline and Grace	Moderate
		Southwest Spokane	
No known impacts in southwest Spokane.			
		Southeast Spokane	
27	HI[2]	Erie and Trent to Napa and Trent	Moderate
27	HI	Erie and Front to Madelia and Front	Moderate
27	LI	Madelia and Main to Magnolia and Main	Moderate
27	LI	Magnolia and Riverside to Crestline and Riverside	Moderate

Footnotes:

[1] LI - Light Industrial - Industrial uses primarily in industrial park development which do not create noise, odors, smoke and other nuisances to the extent of those in heavy industry classification.

[2] HI - Heavy Industrial - Manufacturing with few restrictions.

Table A-4

ALTERNATIVE 1 CONSTRUCTION ACTIVITY PARK IMPACT SUMMARY

CT	Name	Location	Type Park	Activities	Street Access or Area Affected	Severity of Impact
			Northwest Spokane			
5	Franklin Park	Whitehouse and Nebraska	Community	Field sports, tennis, picnicking	Division	Minor
10	Downriver Golf Course	Riverview Drive	Golf course	Golf	Columbia Circle (Storage Basin 13B)	Significant
	Downriver Park	Downriver Drive	Community	Hiking, nature study	Meenach Drive (Storage Basin 12B)	Significant
11	Shadle Park	Belt and Wellesley	Community	Field sports, tennis, swimming, picnicking	Wellesley	Minor
19	Corbin Park	Wall and Park	Neighborhood	Field sports, tennis, picnicking	Washington	Minor
24	Riverfront Park	Washington Street	Major	General entertainment	Riverfront Park recreation areas (Storage Basin 6B)	Significant
			Northeast Spokane			
4	Nevada Field	Nevada and Central	Neighborhood	Field sports	Nevada	Moderate
3	Rochester Heights	Magnolia and Everett	Neighborhood	Field sports, wading pool, picnicking	Everett	Significant
2	Harmon Field	Regal and Bismark	Neighborhood	Field sports, tennis, tot lot	Regal Bismark	Significant
15	Hays Park	Pittsburg and Gordon	Neighborhood	Field sports, picnicking	Crestline	Minor
25	Mission Park	Perry and Mission	Neighborhood	Field sports, tennis, swimming, picnicking	Parking Lot Mission Park (Storage Basin 4B)	Significant
			Southwest Spokane			
37	High Bridge Park	Hangman Creek	Major	Picnicking, fishing, swimming	Adjacent to river (Storage Basin 10B)	Significant
35	Glover Field	Cedar and Main	Neighborhood	Field sports	Maple Bridge area (Storage Basin 8B)	Significant
42	Cannon Hill Park	Lincoln and 18th	Neighborhood	Field sports, winter pond, picnicking	Lincoln	Moderate
42	Manito Park	Grand and 17th	Major	Field sports, tennis, picnicking, gardens	Grand, 25th, Park Drive	Significant
43	Comstock Park	Lincoln and 29th	Community	Field sports, tennis, swimming, picnicking	Wall	Minor
			Southeast Spokane			
31	Liberty Park	Pittsburg and 3rd	Community	Field sports, tennis, swimming, picnicking, tot lot	Denver, portion of park interior	Significant
31	Grant Park	Ivory and 9th	Neighborhood	Field sports, wading pool, tennis	9th, Ivory	Moderate
30	Underhill	Fiske and Hartson	Community	Field sports, wading pool, tennis, picnicking	Hartson	Significant

Table A-5

ALTERNATIVE 1 CONSTRUCTION ACTIVITY
PUBLIC/SEMIPUBLIC FACILITIES
IMPACT SUMMARY

CT	Facility Type/ Name	Location	Street Access Affected	Severity of Impact
Northwest Spokane				
9	Westview School	Moore and Decatur	Bismark	Moderate
10	Downriver Clubhouse	Columbia Circle	Columbia Circle and Parking Lot (Storage Basin 13B)	Significant
10	Rivercrest Convalescent Hospital	Downriver Dr. near Downriver Golf Course	Downriver Drive	Significant
11	Garland School	Belt and Garland	Garland (main access)	Significant
24	North Central High School	Howard and Augusta	Washington	Minor
24	Continuation High School	Calispel and Mission	Augusta and Calispel	Significant
Northeast Spokane				
4	Holy Family Hospital	Lidgerwood and Columbia	Rowan	Moderate
4	Lidgerwood School	Lidgerwood and Rowan	Rowan (main access) Addison	
4	Continuation School	Standard and Wellesley	Addison	Minor
3	Whitman School	Pittsburg and Everett	Rowan	Minor
2	Spokane Branch Library	Haven	Haven	Significant
14	Longfellow School	Nevada and Cincinnati	Nevada	Moderate
16	Shaw Junior High	Cook and Regal	Regal Rich	Moderate
Southwest Spokane				
35 and 34 (Central Business District)	Fire Station	Cedar and Sprague	Cedar	Significant
	PNB Telephone Building	Stevens and 2nd	Stevens	Moderate
32	Rockwood Park Clinic	Bernard and 8th	Bernard and 8th	Significant
32	Sacred Heart Hospital	8th	McClellan	Moderate
Southeast Spokane				
31	Grant School	Ivory and 10th	Arthur and 9th	Moderate
46	Lincoln Heights School	Ray and 21st	Ray	Moderate

Table A-6

ALTERNATIVE 3 CONSTRUCTION ACTIVITY
RESIDENTIAL IMPACT SUMMARY

	Housing Types		
CT	Single-Family	2 or More Units in Structure	Severity of Impact
Northwest Spokane			
9	x	x	Significant
7	x		Moderate
6	x		Minor
5	x	x	Moderate
10	x		Significant
11	x		Significant
12	x	x	Significant
13	x	x	Significant
21	x	x	Significant
20	x	x	Significant
19	x	x	Minor
23	x	x	Moderate
24	x	x	Significant
Northeast Spokane			
4	x	x	Significant
3	x	x	Moderate
2	x	x	Significant
14	x	x	Moderate
15	x	x	Moderate
16	x	x	Moderate
17	x		Minor
18	x	x	Significant
25	x	x	Moderate
Southwest Spokane			
38	x	x	Moderate to Significant
35		x	Minor
34		x	Minor
40	x	x	Significant
32		x	Significant
41	x	x	Significant
42	x		Significant
43	x		Significant
Southeast Spokane			
33			Minimal
26	x	x	Significant
27		x	Minimal
28		x	Minimal
31	x	x	Significant
30	x	x	Moderate
29	x		Significant
45	x	x	Significant
46	x	x	Significant
44	x		Moderate
47	x	x	Minor

Table A-7

ALTERNATIVE 3 CONSTRUCTION ACTIVITY
COMMERCIAL IMPACT SUMMARY

CT	Commercial Type	Location	Severity of Impact
Northwest Spokane			
9	LB	Driscoll and Rowan	Minor
9	LB	Fotheringham and Central	Moderate
7	LB	Alberta and Rowan	Moderate
7	LB	Ash and Wellesley	Moderate
6	LB	Ash and Rowan	Moderate
10	Tourist	Downriver Golf Course Pro Shop	Significant
11	CB[2]	Alberta and Wellesley (Shadle Center)	Significant
11	LB	Oak and Garland	Moderate
12 and 13	CB	Jefferson and Garland to Howard and Garland	Significant
13	LB	Division and Gray Court	Moderate
21	CB	Northwest and Jackson	Minor
20	CB	Ash and Mansfield to Ash and Shannon	Moderate
20	CB	Ash and Sinto to Cedar and Sharp	Moderate
19	CB	Howard and Shannon to Division and Shannon	Moderate
19	CB	Monroe and Dalton to Monroe and Frederick	Moderate
23	LB	Cochran and Boone	Moderate
23	LB	Hollis and Gardner	Moderate
23	LB	Cochran and Broadway	Moderate
23	LB	Nettleton and Broadway	Minor
23	CB	Elm and Broadway	Minor
23	CI	Ash and Bridge	Moderate
24	CB	Walnut and Boone	Moderate
	CB	Maple and Dean to Cedar and Dean	Moderate
24	CBD	Monroe and Boone to Lincoln and Boone	Moderate
24	CBD	Howard and Dean to Howard and Catoldo	Moderate
24	CB	Washington and Boone to Washington and Catoldo	
24	CBD	Monroe and Mallon to Post and Mallon	Moderate
24	CBD	Monroe and Broadway to Post and Broadway	Moderate
Northeast Spokane			
4	CB	Division and Wellesley (Northtown Center)	Minor
3	CB	Perry and Decatur	Minor
2	LB	Haven and Broad	Moderate
14	LB	Nevada	Significant
Southwest Spokane			
38	LB	"A" and 3rd to "A" and 5th (High Bridge Park)	Significant
38	LB	"A" and Hartson	Moderate
35 and 34 (Central Business District [CBD])	CBD	Spokane Falls Blvd. (Riverside to Division)	Significant
	CBD	Main (Stevens to Division)	Significant

Table A-7 con't.

CT	Commercial Type	Location	Severity of Impact
35 & 34	CBD	Lincoln (Spokane Falls Blvd. to Riverside)	Significant
"	CBD	Riverside (Cedar to Howard	Significant
"	CBD	Riverside (Bernard to Division)	Significant
"	CBD	Monroe (Main to 1st)	Significant
"	CBD	Sprague (Adams to Wall)	Significant
"	CBD	Sprague (Stevens to Washington)	Significant
		Sprague (Bernard to Division)	
"	CBD	1st (Cedar to Adams)	Moderate
"	CBD	1st (Monroe to Howard)	Significant
		1st (Stevens to Washington	Significant
		Adams (Sprague to 1st)	Moderate
		Jefferson (Sprague to 1st)	Moderate
41	LB	Grand and 13th	Moderate
40	LB	Adams and 14th	Moderate
7	LB	Lincoln and 14th	Moderate
32	CB	Washington and 6th	Significant
Southeast Spokane			
33	Cl	Sprague, Pacific, 2nd St., 3rd St., Hatch	Moderate
26	LB	Napa and Mission	Moderate
	CB	Regal and Mission	Significant
27	CB	Napa and 1st Riverside and 1st	Significant
27	Cl	Hogan and Riverside, Napa and Riverside	Moderate
27	Cl	Lee and Sprague to Regal and Sprague	Moderate
27	Cl	Perry and 1st to Regal and 1st	Moderate
27	Cl	Madelia and 2nd to Regal and 2nd	Moderate
28	CB	Havana and Sprague (Eastown Center)	Significant
31	CB	7th and Perry to 12th and Perry	Significant
31	LB	Southeast Blvd. and 10th	Moderate
31	LB	Helena and 16th	Moderate
31	LB	Altamont and 5th	Moderate
31	LB	Haven and 5th	Moderate
45	LB	Grand and 16th to Grand and 17th	Moderate
	LB	Grand and 24th	Moderate
44	CB	Grand and 29th Grand and 31st (Manito Center)	Significant

Footnotes:

[1] LB - Local Business - smaller neighborhood shopping facilities consisting of retail and service establishments.

[2] CB - Community Business - varied retail, service, and office establishments serving wide selection of goods to several neighborhoods.

[3] CI - Commercial Zone - variety of businesses, warehouses, and light industrial uses in commercial park developments.

[4] CBD - Central Business District/Zone - stores, offices, service establishments, hotels, government and cultural centers at central focal point of city's arterials and transportation systems.

Table A-8

ALTERNATIVE 3 CONSTRUCTION ACTIVITY INDUSTRIAL IMPACT SUMMARY

CT	Industrial Type	Location	Severity of Impact
		Northwest Spokane	
21	LI[1]	Elm to Maxwell to Ash and Maxwell	Minor
20	LI	Adams and Sharp adjacent to U. P. Railroad	Moderate
24	LI	Lincoln and Mallon	Moderate
	LI	Lincoln and Broadway	Moderate
	LI	Howard and Catoldo to Washington and Catoldo	Moderate
	LI	Atlantic and Catoldo	Moderate
		Northeast Spokane	
14	LI	Vicinity of GN Railroad tracks	Minor
15	LI	Vicinity of GN Railroad tracks	Moderate
16	LI	Vicinity of GN Railroad tracks	Moderate
18	LI	Vicinity of GN Railroad tracks	Moderate
25	LI	Vicinity of GN Railroad tracks	Moderate
		Southwest Spokane	
35 & 34 (Central Business District)	LI	Madison and Sprague	Moderate
	LI	Cedar and Burlington Northern tracks	Moderate
	LI	Spokane Falls Boulevard	Minor
	LI	Browne and Riverside	Minor
	LI	Washington and 1st	Minor
	LI	Browne and Pacific	Minor
	LI	Washington and 3rd	Moderate
		Southeast Spokane	
33	LI	Division and Trent to Sherman and Trent	Moderate
33	LI	Division and Sprague to Arthur and Sprague	Moderate
33	LI	Spokane and Pacific to Sherman and Pacific	Moderate
33	LI	Division and 2nd to Sherman and 2nd	Moderate
33	LI	Division and 3rd to Sherman and 3rd	Moderate

CT	Industrial Type	Location	Severity of Impact
27	LI	Nelson and 1st	Moderate
27	LI	Hogan and Riverside to Magnolia and Riverside	Moderate
27	LI	Lee and Main to Altamont and Main	Moderate
27	HI	Division and Trent to Freya and Trent (includes Hanson Industrial Park)	Moderate
27	LI		
27	HI	Helena and Springfield to Napa and Springfield	Moderate
28	HI	Haven and Boone, Ralph and Syndicate	
28	LI		
28	HI	Syndicate and Alki to Springfield and Thor	Moderate
28	HI	Haven and Ferry to Ralph and Ferry	Moderate
28	HI	Haven and Olive to Haven and Riverside	Moderate
28	HI	Sycamore and Alki to Sycamore and Riverside	Moderate
28	HI	Haven and Riverside to Havana and Riverside	Moderate
28	HI	Havana - Alki and Havana to Sprague and Havana (includes Trumark Industrial Park)	Moderate

Footnotes:

[1] LI - Light Industrial - Industrial uses primarily in industrial park development which do not create noise, odors, smoke and other nuisances to the extent of those in heavy industry classification.

[2] HI - Heavy Industrial - Manufacturing with few restrictions.

Table A-9

ALTERNATIVE 3 CONSTRUCTION ACTIVITY
PARK IMPACT SUMMARY

CT	Name	Location	Type Park	Major Activities	Street Access Affected	Severity of Impact
Northwest Spokane						
9	Riverside State Park	Downriver Drive	Major State Park		Northwest Blvd.	Minor
5	Franklin Park	Whitehouse and Nebraska	Community	(See Table A-4)	Nebraska, Whitehouse, Queen	Significant
10	Downriver Golf Course	Riverview Drive	Golf Course	(See Table A-4)	Riverview, Alice, Euclid	Significant
11	Shadle Park	Belt and Wellesley	Community	(See Table A-4)	Fairview, Cleveland, Wellesley, Longfellow	Significant
11	Drummeler Springs	Ash and Euclid	Neighborhood	Hiking, Biking	Euclid	Minor
13	Clark Playground	Normandie and LaCrosse	Neighborhood	Field Sports, Picnicking	Lacrosse, Walton, Garland	Significant
21	A. M. Cannon	Belt and Mission	Neighborhood	Field Sports, Tennis, Swimming	Mission, Belt, Maxwell	Significant
19	Corbin Park	Wall and Park	Neighborhood	(See Table A-4)	Wall and Stevens	Significant
24	Riverfront Park	North Side	Major	(See Table A-4)	Howard, Washington, Broadway	Significant
Northeast Spokane						
4	Nevada Field	Nevada and Central	Neighborhood	(See Table A-4)	Nevada	Moderate
3	Rochester Heights	Magnolia and Everett	Neighborhood	(See Table A-4)	Everett	Significant
2	Harmon Field	Regal and Bismark	Neighborhood	(See Table A-4)	Regal and Haven	Moderate
2	Hillyard Pool	Havana and Columbia	Swimming Pool		Havana and Joseph	Moderate
14	Glass Park	Standard and Meroy	Neighborhood	Field Sports, Wading Pool, Picnicking	Standard and Meroy	Moderate
14	Byrne Park	Lidgerwood and Walton	Neighborhood	Picnic	Lidgerwood	Moderate
15	Hays Park	Pittsburg and Gordon	Neighborhood	(See Table A-4)	Pittsburgh	Minor
16	Courtland	Stone and Glass	Neighborhood	Field Sports	Stone and Bridgeport	Moderate
25	Mission Park	Perry and Mission	Neighborhood	(See Table A-4)	Mission and Superior	Significant

Table A-9 con't.

CT	Name	Location	Type Park	Major Activities	Street Access Affected	Severity of Impact
Southwest Spokane						
37 & 38	High Bridge Park	Junction of Hangman Creek and Spokane River	Major	(See Table A-4)	Government Way, "A" St., 5th St.	Significant
38	Indian Canyon Golf Course	West Drive	Golf Course	Golf	West Drive	Minor
35	Riverfront Park	Spokane Falls Blvd.	Major	General Entertainment	Spokane Falls Blvd.	Significant
35	Lincoln Plaza	Lincoln and Riverside	Park Plaza	Urban Rest Area	Lincoln and Riverside	Significant
32	Pioneer Park	Stevens and 7th	Neighborhood	Arts and Crafts, Passive Rec.	7th St.	Minor
42	Cannon Hill Park	Lincoln and 8th	Neighborhood	(See Table A-4)	Lincoln, 18th, Shoshone, Stevens	Significant
42	Manito Park	Grand and 17th	Major	(See Table A-4)	18th, Manito, Grand, 25th, 21st.	Significant
43	Hart Field	Grand and 33rd		Baseball	Division and 37th	Moderate
43	Comstock Park	Lincoln and 29th	Community	(See Table A-4)	Lincoln, Post, Wall, Howard, 33rd	Significant
Southeast Spokane						
26	Chief Gary Park	Cook and Mission	Neighborhood	Field Sports, Picknicking	Mission and Sinto	Significant
31	Grant Park	Ivory and 9th	Neighborhood	(See Table A-4)	Ivory and Arthur	Moderate
31	Liberty Park	Pittsburg and 3rd	Community Park and Pool	Swimming, Field Sports, Tennis, Picknicking	Perry and 3rd Avenue	Moderate
30	Underhill	Fiske and Hartson	Community	(See Table A-4)	Hartson and Fiske	Significant
46	Lincoln Park	Southeast Blvd. and 17th	Community	Wading Pool, Picknicking, Scenic Drive	17th	Moderate
	Lincoln Heights Park	Ray and 25th	Unknown	Unknown	Ray and Regal	Significant
47	Hamblen Park	Napa and 37th	Community	Field Sports, Tennis, Picknicking	37th, Napa, Crestline	Significant

Table A-10

ALTERNATIVE 3 CONSTRUCTION ACTIVITY PUBLIC/SEMIPUBLIC FACILITIES IMPACT SUMMARY

CT	Facility Type/ Name	Location	Street Access Affected	Severity of Impacts
		Northwest Spokane		
9	Westview School	Moore and Decatur	Bismark	Moderate
5	Madison School	Whitehouse and Nebraska	Nebraska (main access), Whitehouse	Significant
10	Down River Clubhouse	Columbia Circle	Columbia Circle, Alice, Euclid, Fairview, Cleveland, Riverview	Significant
11	Glover Park Junior High	Alberta and Longfellow	Longfellow	Minor
11	Shadle Park High School	Princeton and Oak	Longfellow, Heroy, Princeton	Moderate
11	Garland School	Belt and Garland	Garland (main access), Belt	Significant
13	Willard School	Wall and Longfellow	Longfellow (main access), Heroy	Significant
21	Audubon School	Elm and Carlisle	Elm (main access), Cannon	Significant
20	Bancroft School	Madison and Spofford	Spofford (main access), Madison	Significant
23	Shriners Hospital for Crippled Children	Summit Boulevard	"A"	Significant
23	Holmes School	Cochran and Sharp	Cochran (main access)	Significant
24	North Central High School	Howard and Augusta	Augusta (main access), Howard	Significant
24	Continuation High School	Calispel and Mission	Mission and Calispel (main access)	Significant
24	Bryant School	Ash and Broadway	Ash (main access)	Significant
24	KXLY-KXLY-TV	Washington and Boone	Boone	Minor
24	County Shops	Cedar and Dean	Dean	Moderate
24	Spokane Transit System	Adams and Boone	Boone, Adams, Gardner	Significant
24	County Courthouse	Madison and Mallon	Broadway	Minor
24	County Courthouse Complex	Broadway	Broadway and College	Moderate
24	Coliseum	Howard and Boone	Howard and Boone	Significant
24	YWCA	Lincoln and Broadway	Broadway	Moderate
24	Civic Theater	Dean and Howard	Howard	Significant

CT	Facility Type/ Name	Location	Street Access Affected	Severity of Impact
		Northeast Spokane		
4	Holy Family Hospital	Lidgerwood and Columbia	Columbia and Lidgerwood	Significant
4	Lidgerwood School	Lidgerwood and Rowen	Lidgerwood (main access not affected)	Minor
4	Continuation School	Standard and Wellesley	Standard (main access not affected)	Moderate
3	Whitman School	Pittsburg and Everett	Everett and Pittsburg	Moderate
2	Spokane Branch Library	Haven Street	Haven Street	Significant
14	Longfellow School	Nevada and Providence	Nevada and Cincinnati (main access not affected)	Moderate
15	John Rogers High School	Perry and Wellesley	Perry, Hogan and Pittsburg	Significant
15	Gonzaga Prep School	Perry and Euclid	Nevada and Perry	Moderate
16	Regal School	Regal and Heroy	Regal (main access)	Significant
	Shaw Junior High	Cook and Walton	Cook and Regal	Moderate
	Bemiss School	Stone and Bridgeport	Bridgeport (main access), Stone	Significant
25	St. Joseph's Home	Dakota and Mission	Standard	Minor
25	Gonzaga Law School	Standard and Sharp	Standard	Moderate
25	Gonzaga University	Astor and Boone	Boone	Moderate
25	Holy Name Academy	Superior and Sharp	Superior	Significant
		Southwest Spokane		
35 & 34 (Central Business District)	Federal Building	Monroe and Main	Monroe, Main, Lincoln	Significant
	City Hall	Wall and Spokane Falls Blvd.	Spokane Falls Blvd.	Moderate
	Fire Station	Adams and 1st	Adams and 1st	Significant
	Elk's Temple	Riverside	Riverside	Moderate
	Masonic Temple	Riverside	Riverside	Moderate
	Chamber of Commerce	Riverside	Riverside	Moderate
	Spokane Club	Riverside	Riverside	Moderate
	Red Cross	Riverside and Jefferson	Riverside, Sprague	Significant
	Our Lady of Lourdes Cathedral and Academy	Madison and Riverside	Riverside and Sprague	Significant
	Chancery Bldg.	Madison and Riverside	Riverside, and Sprague	Significant
	Greyhound Bus Depot	Jefferson and Sprague	Jefferson and Sprague	Significant
	Spokane Daily Chronicle	Monroe and Sprague	Monroe, Sprague Riverside	Significant
	B.O.P. Club	Monroe and 3rd	3rd	Moderate
	Carousel	Riverfront Park	Spokane Falls	Significant
	Opera House	Riverfront Park	Spokane Falls	Significant
	Convention Center	Riverfront Park	Spokane Falls	Significant
	Burlington Northern	Bernard and Sprague	Sprague	Significant
32	Lewis and Clark School	Wall and 4th	4th (main access), 5th	Significant

CT	Facility Type/ Name	Location	Street Access Affected	Severity of Impact
32	Deaconess Hospital	5th	5th (main access)	Significant
32	Rockwood Park Clinic	Bernard and 8th	Bernard	Significant
32	Sacred Heart Hospital	8th	McClellan and 9th	Moderate
32	St. Lukes Hospital	Cowley	Cowley	Moderate
42	Wilson School	Monroe and 25th	25th (main access), Monroe, Lincoln	Significant
43	Sacajawea Junior High	Lamonte and 33rd	Grand	Minor
	Jefferson School	Grand and 37th	Grand (main access)	Significant
		Southeast Spokane		
26	Stevens School	Pittsburg and Sinto	Sinto (main access), Mission, Pittsburg	Significant
27	Libby Junior High	Regal and Pacific	1st (main access), Pacific	Significant
	Playfair Race Track	Regal	Regal and Sprague	Significant
31	Grant School	Ivory and 10th	Ivory	Moderate
29	Sheridan School	Freya and 5th	Freya	Moderate
45	Hutton School	Arthur and 24th	Plateau Road	Moderate
46	Franklin School	Mount Vernon and 17th	Mount Vernon	Moderate
	Lincoln Heights School	Ray and 21st	21st (main access), Ray, Thor	Significant

APPENDIX B

WATER QUALITY SUPPORT DATA

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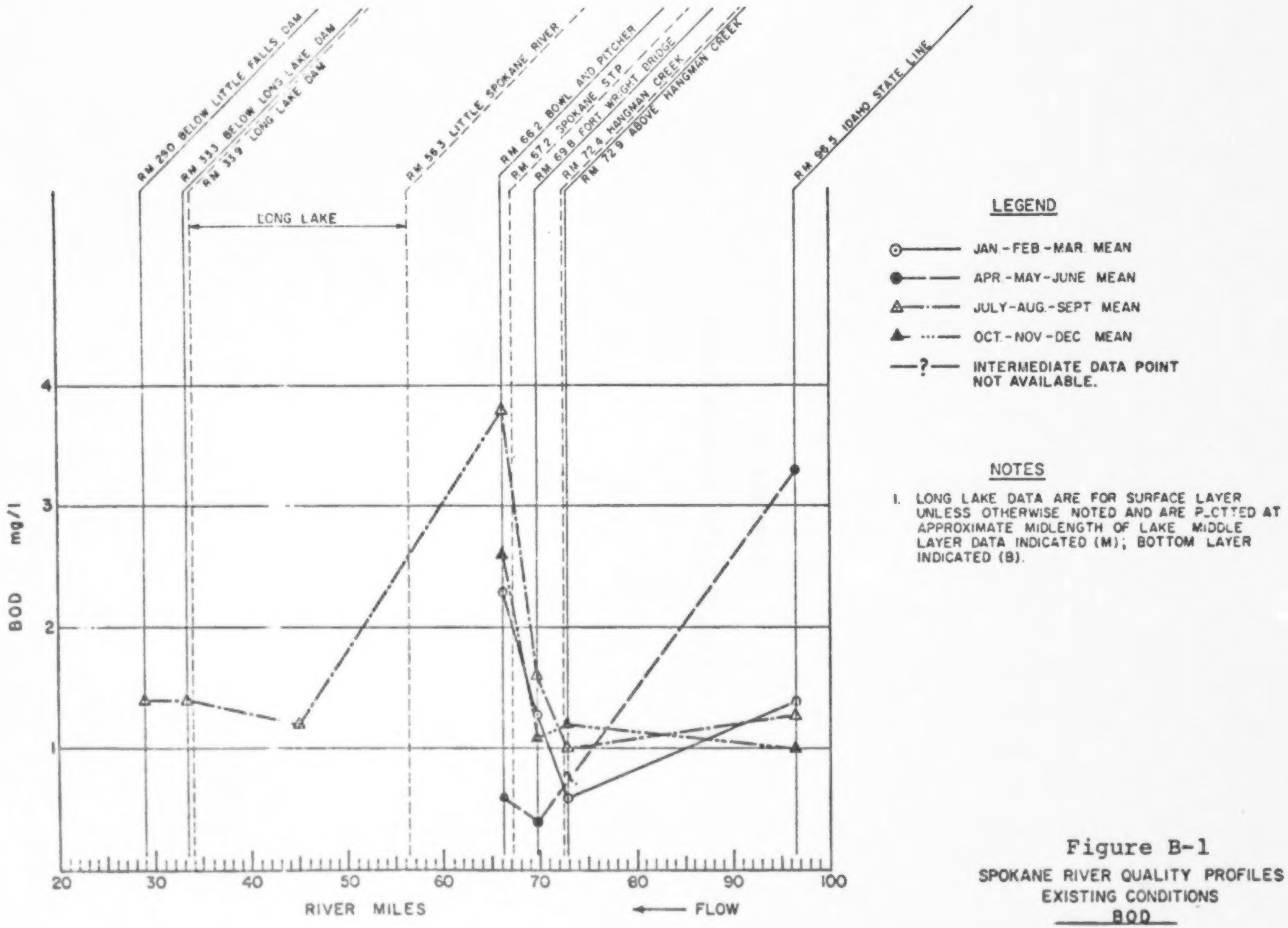


NOTES

1. LONG LAKE DATA ARE FOR SURFACE LAYER UNLESS OTHERWISE NOTED AND ARE P_CTTED AT APPROXIMATE MIDLENGTH OF LAKE. MIDDLE LAYER DATA INDICATED (M); BOTTOM LAYER INDICATED (B).

Figure B-1
SPOKANE RIVER QUALITY PROFILES
EXISTING CONDITIONS
BOD

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

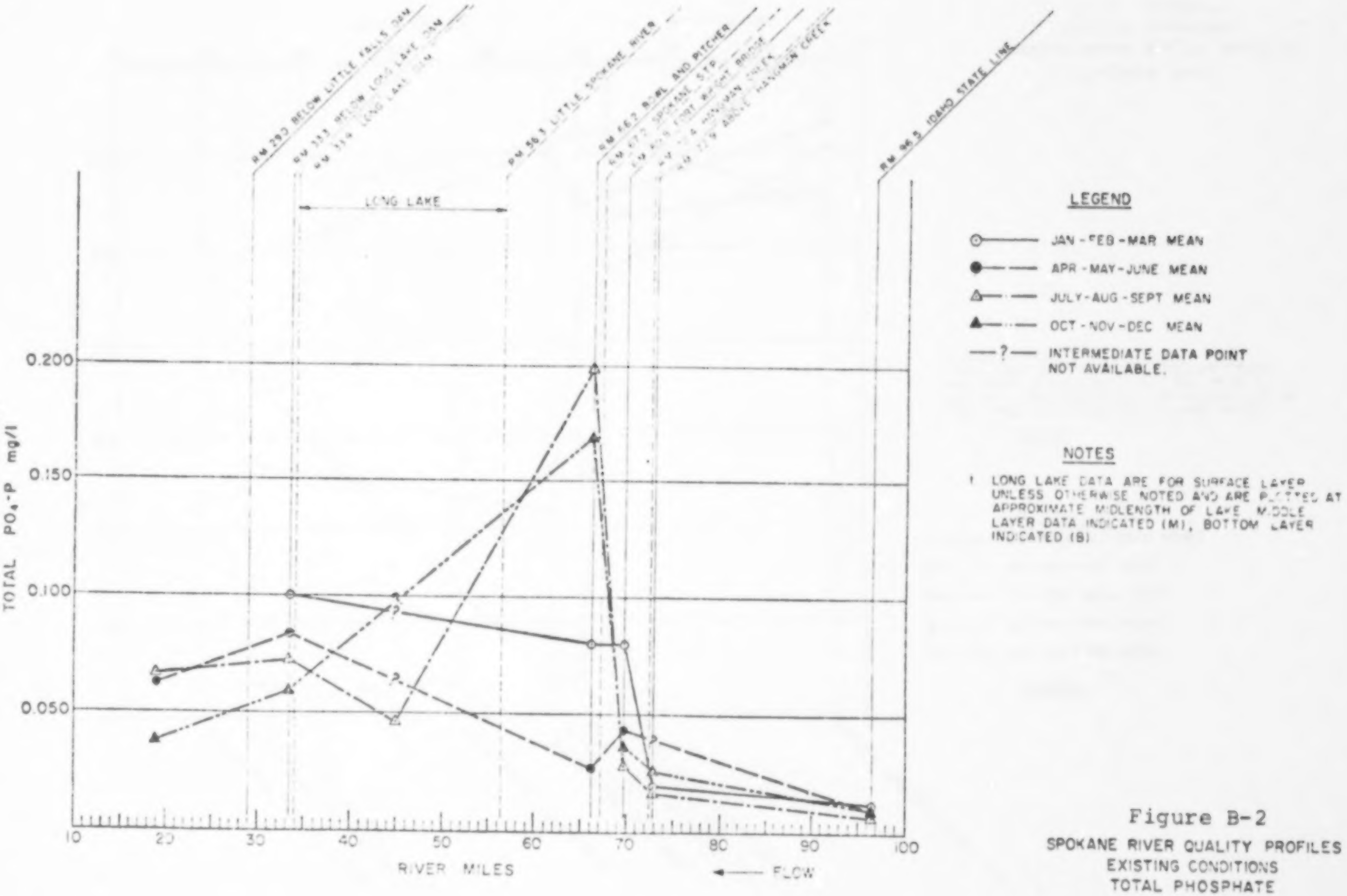
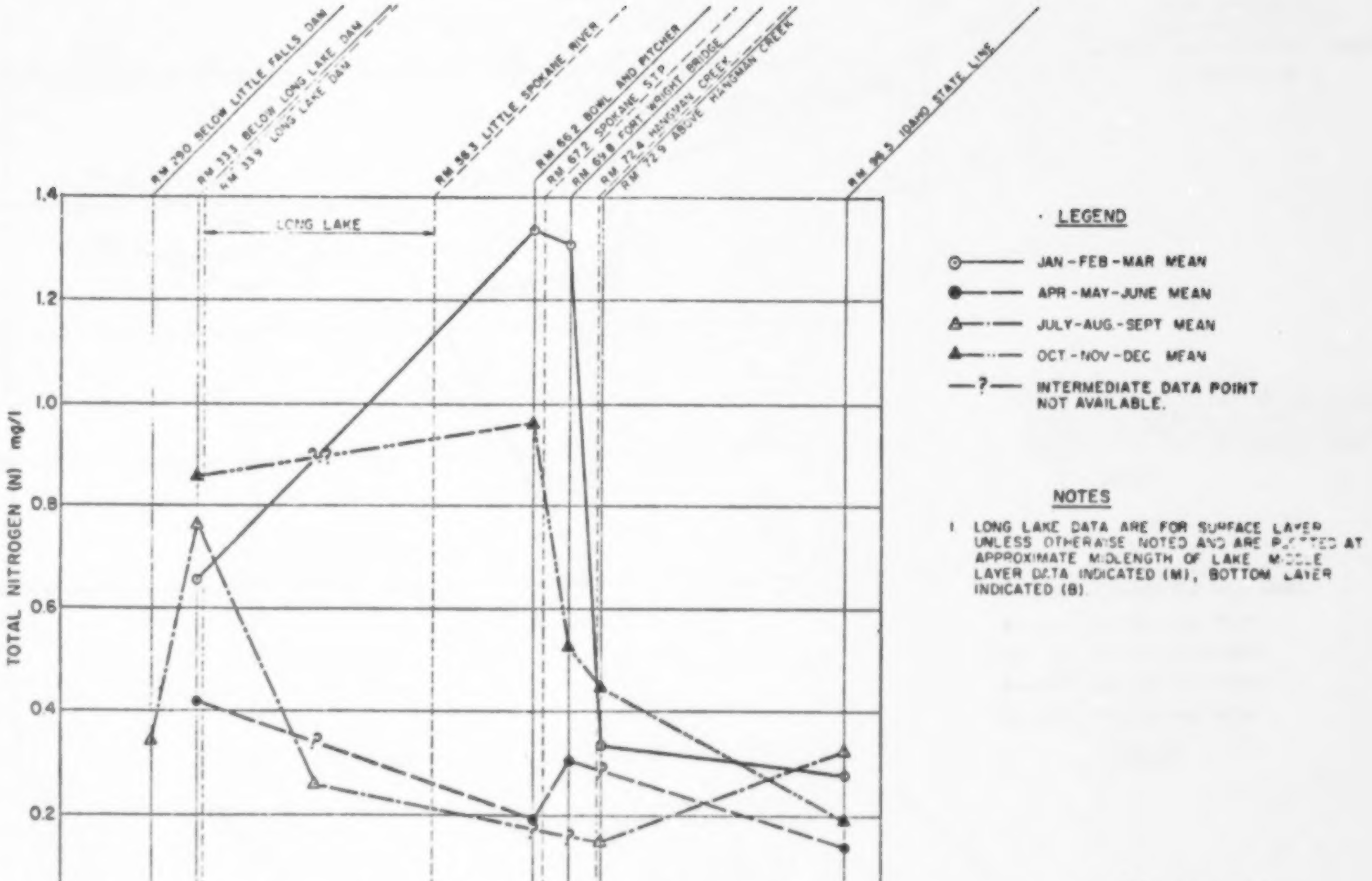


Figure B-2
SPOKANE RIVER QUALITY PROFILES
EXISTING CONDITIONS
TOTAL PHOSPHATE

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Reproduced from best available copy.

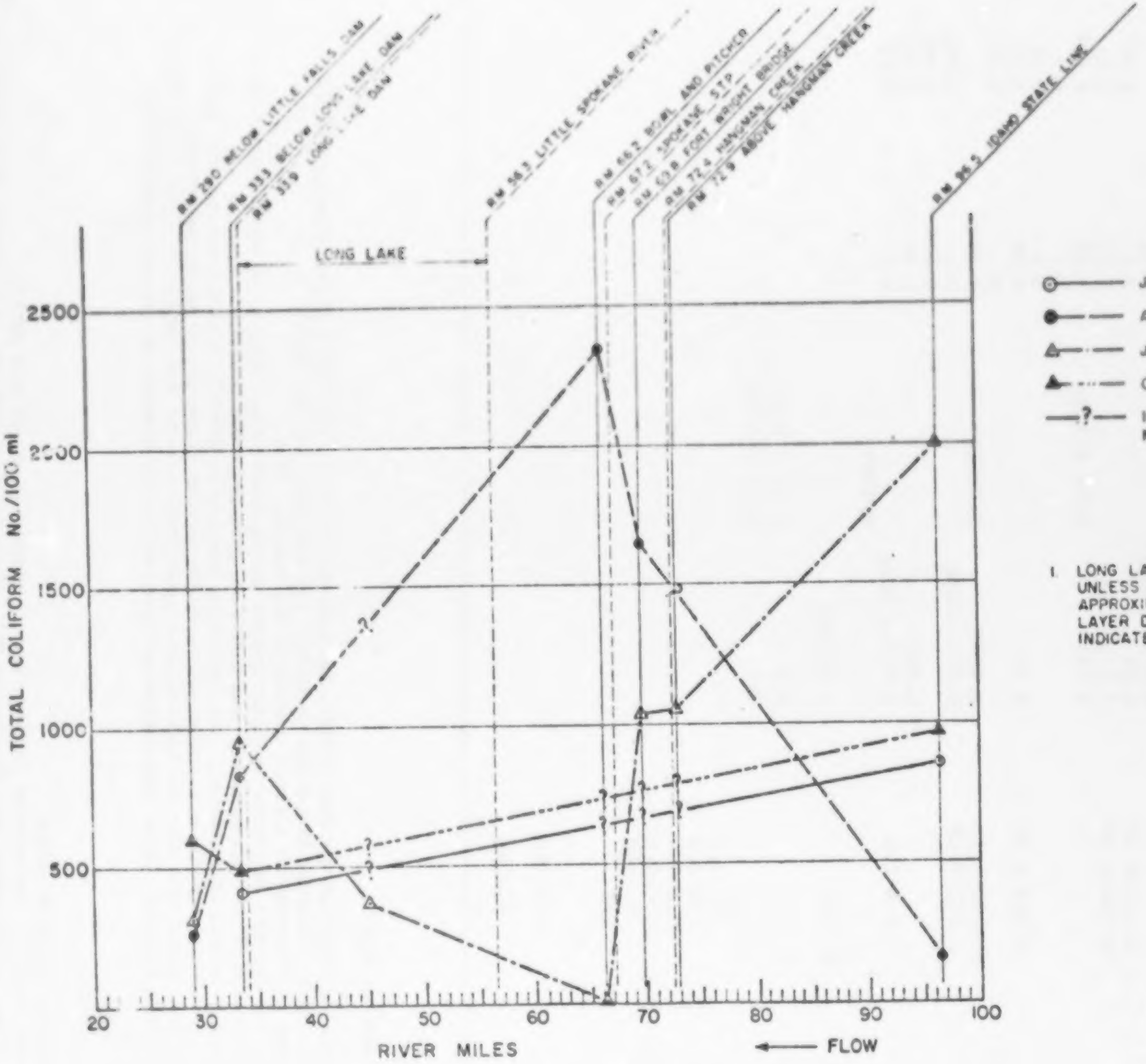


NOTES

1 LONG LAKE DATA ARE FOR SURFACE LAYER UNLESS OTHERWISE NOTED AND ARE PLOTTED AT APPROXIMATE MIDLENGTH OF LAKE. MIDDLE LAYER DATA INDICATED (M), BOTTOM LAYER INDICATED (B).

Figure B-3
SPOKANE RIVER QUALITY PROFILES
EXISTING CONDITIONS
TOTAL NITROGEN

SOURCE: U. S. Department of Army, Corps of Engineers, 1978, Appendix A



LEGEND

- ○——— JAN-FEB-MAR MEAN
- ●— — APR-MAY-JUNE MEAN
- △-·— JULY-AUG-SEPT MEAN
- ▲-··— OCT-NOV-DEC MEAN
- —?— INTERMEDIATE DATA POINT NOT AVAILABLE

NOTES

1. LONG LAKE DATA ARE FOR SURFACE LAYER UNLESS OTHERWISE NOTED AND ARE PLOTTED AT APPROXIMATE MIDLENGTH OF LAKE. MIDDLE LAYER DATA INDICATED (M); BOTTOM LAYER INDICATED (B).

Figure B-4
SPOKANE RIVER QUALITY PROFILES
EXISTING CONDITIONS
TOTAL COLIFORM

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-1

COMPARISON OF TYPICAL URBAN RUNOFF WATER QUALITY AND RECOMMENDED WATER QUALITY CRITERIA

		Recommended Water Quality Criteria for Protection of[2]			
		Freshwater Biota		Marine Biota	
Pollutant	Typical Concentrations in Urban Runoff[1]	Upper Limit	Average Concentration	Hazard to Marine Life	Threshold of Minimal Risk
Aluminum			0.1	1.5	0.2
Ammonia (unionized[4])		0.02	0.05 x LC_{50}[3]	0.4	0.01
(as nitrogen)	0.3-1.2				
Arsenic				0.05	0.01
Cadmium[5] (hard water[6])	0.004-0.005	0.03[8]/0.003[9]		0.01	0.0002
(soft water[7])		0.004[8]/0.0004[9]			
Chlorine (free)		0.003 (0.05)[10]		0.01	
Chromium	0.036-0.18	0.05		0.1	0.005
Copper[8]	0.046-0.33	0.1 x LC_{50}		0.05	0.01
Cyanide		0.005	0.05 x LC_{50}	0.01	0.005
Fluoride				1.5	0.5
Iron				0.3	0.05
Lead	0.044-0.93	0.03		0.05	0.01
Manganese (total)				0.1	0.02
Mercury	0.0005-0.12	0.0002	0.00005	0.0001	
Nickel	0.032-0.08	0.02 x LC_{50}		0.1	0.002
Silver				0.005	0.001
Sulfides[11]		0.002		0.01	0.001
Zinc[5]	0.4-1.1	0.005 x LC_{50}		0.1	0.02
Pthalate esters			0.0003		
Polychlorinated biphenyls (PCB)	0.0018	0.000002			
Linear alkyl sulfnate (LAS)		0.2	0.05 x LC_{50}		
Phenolics		0.1	0.05 x LC_{50}		
Oil and grease	13				
Organic nitrogen	0.8-3.5				
Nitrate nigrogen	0.4-2.9				
Total phosphate	0.2-4.3				
Dissolved phosphate	0.14-0.57				
Suspended solids	74-380				
Volatile solids	298				
Biochemical oxygen demand (BOD)	4.3-160				
Chemical oxygen demand (COD)	85-179				

NOTES AND SOURCES:

All concentrations given as mg/l.

[1] Based on values reported in Sartor and Boyd (1972); Southern California Coastal Water Research Project (1973); Loehr (1974); Bryan (1974); Whipple, Hunter and Yu (1974); and Kluesener and Lee (1974).

[2] From National Academy of Sciences and National Academy of Engineering, 1972.

[3] LC_{50} = 96-hour LC_{50} for the most sensitive important species in the local area. LC_{50} = the concentration of a substance which produces a 50 percent mortality rate during the indicated time period.

[4] Toxicity is due largely to unionized ammonia. The ionization reaction is directly proportional to pH. Thus, toxicity of dissolved ammonia increase with higher pH due to the greater proportion of unionized ammonia.

[5] Combinations of cadmium, copper and zinc are known to have synergistic effects when cooper or zinc are present in concentrations of 1 mg/l or more. Other combinations of heavy metals may interact to produce synergistic or antagonistic effects.

[6] Hardness >100 mg/l $CaCO_3$.

[7] Hardness ≤100 mg/l $CaCO_3$.

[8] Most aquatic life.

[9] Crustaceans and eggs or larvae of salmon.

[10] Value in parentheses should not be exceeded for more than 30 minutes in any 24-hour period.

[11] Toxicity is largely due to H_2S rather than the ionized HS^-. The ionization reaction is inversely proportional to pH. At a pH of 6.0, about 92 percent of total sulfide will be present as H_2S; at a pH of 7.0, about 50 percent will be H_2S; at a pH of 8.0, about 9 percent will be H_2S. Inorganic sulfides are also highly toxic.

Table B-2

SURFACE WATER QUALITY SUMMARY
STATELINE

		MEAN VALUES			
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	4.2	9.8	19.4	8.5
Dissolved oxygen	mg/l	12.6	11.1	9.0	10.2
B.O.D.	mg/l	1.4	3.3	1.3	1.0
Total phosphorus -P	mg/l	0.013	0.011	0.008	0.010
Ammonia -N	mg/l	0.066	0.108	0.088	0.029
Total N	mg/l	0.279	0.143	0.326	0.192
Total coliforms	No./100 ml	868	177	2002	986
Zinc	μg/l	241	248	168	261

*Less than 5 data points.

Table B-3

SURFACE WATER QUALITY SUMMARY
SPOKANE RIVER ABOVE HANGMAN CREEK

		MEAN VALUES			
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	4.2	13.2*	14.2	6.8
Dissolved oxygen	mg/l	13.2	11.7*	9.7	11.4
B.O.D.	mg/l	0.6*	-	1.0	1.2
Total phosphorus -P	mg/l	0.020*	-	0.017	0.026
Ammonia -N	mg/l	0.050*	-	0.044*	0.073
Total N	mg/l	0.335*	-	0.150*	0.449
Total coliforms	No./100 ml	-	-	1068	-
Zinc	μg/l	285*	-	78*	174

*Less than 5 data points.

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-4

SURFACE WATER QUALITY SUMMARY
HANGMAN CREEK AT MOUTH

		MEAN VALUES			
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	3.6	17.1	15.2	5.6
Dissolved oxygen	mg/l	12.8	9.7	8.6	12.6
B.O.D.	mg/l	-	-	11.8*	-
Total phosphorus -P	mg/l	0.395*	-	0.085*	0.258
Ammonia -N	mg/l	0.642	0.180*	0.104	0.205
Total N	mg/l	2.61	2.36*	1.96	1.38
Total coliforms	No./100 ml	-	-	323*	-
Zinc	µg/l	42*	27*	7	9*

*Less than 5 data points.

Table B-5

SURFACE WATER QUALITY SUMMARY
SPOKANE RIVER AT FT. WRIGHT BRIDGE

		MEAN VALUES			
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	4.2	12.3	16.7	6.7
Dissolved oxygen	mg/l	12.5	11.4	9.6	11.7
B.O.D.	mg/l	1.3*	0.4*	1.6*	1.1
Total phosphorus -P	mg/l	0.079	0.043	0.028	0.036
Ammonia -N	mg/l	0.018	0.009	0.017	0.059
Total N	mg/l	1.314*	0.310	-	0.527
Total coliforms	No./100 ml	-	1644*	1050*	-
Zinc	µg/l	213*	190	85*	139

*Less than 5 data points.

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-6

SURFACE WATER QUALITY SUMMARY
SPOKANE RIVER AT BOWL & PITCHER

Parameter	Units	MEAN VALUES Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	4.9	13.8	15.1*	6.9
Dissolved oxygen	mg/l	12.5	10.6	9.9*	11.5
B.O.D.	mg/l	2.3*	0.6*	3.8*	2.6
Total phosphorus -P	mg/l	0.080*	0.027*	0.198*	0.168
Ammonia -N	mg/l	0.230*	0.028*	0.180*	0.447
Total N	mg/l	1.336*	0.195*	-	0.964
Total coliforms	No./100 ml	-	2343*	20*	-
Zinc	µg/l	235*	240*	127*	172

*Less than 5 data points

Table B-7

SURFACE WATER QUALITY SUMMARY
LITTLE SPOKANE RIVER NEAR MOUTH

Parameter	Units	MEAN VALUES Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	5.2	12.4	13.5	7.0
Dissolved oxygen	mg/l	10.5	8.9	8.8	10.5
B.O.D.	mg/l	1.1*	0.8*	0.5*	-
Total phosphorus -P	mg/l	0.086	0.084	0.039	0.030
Ammonia -N	mg/l	0.077	0.042	0.064	0.042
Total N	mg/l	1.300	1.105	1.530	1.206
Total coliforms	No./100 ml	1802	1012	1776	880*
Zinc	g/l	42	43*	4	15

*Less than 5 data points

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-8

SURFACE WATER QUALITY SUMMARY
LONG LAKE

SURFACE LAYER (1.0 M DEPTH)

			MEAN VALUES		
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	-	17.5	21.2	13.2
Dissolved oxygen	mg/l	-	11.2	10.7	9.4
B.O.D.	mg/l	-	-	1.2*	-
Total phosphorus -P	mg/l	-	-	0.046	-
Ammonia -N	mg/l	-	-	0.019*	-
Total N	mg/l	-	-	0.263*	-
Total coliforms	No./100 ml	-	-	385	-
Zinc	µg/l	-	-	20*	-

MIDDLE LAYER (15.0 M DEPTH)

			MEAN VALUES		
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	-	14.6	16.8	6.5
Dissolved oxygen	mg/l	-	12.2	3.0	4.8
B.O.D.	mg/l	-	-	0.5*	-
Total phosphorus -P	mg/l	-	-	0.097	-
Ammonia -N	mg/l	-	-	0.116*	-
Total N	mg/l	-	-	0.28*	-
Total coliforms	No./100 ml	-	-	600*	-
Zinc	µg/l	-	-	-	-

BOTTOM LAYER (24.0 M DEPTH)

			MEAN VALUES		
Parameter	Units	Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	-	13.2	14.2	11.6
Dissolved oxygen	mg/l	-	4.1	2.2	4.4
B.O.D.	mg/l	-	-	3.1*	-
Total phosphorus -P	mg/l	-	-	0.378*	-
Ammonia -N	mg/l	-	-	1.130*	-
Total N	mg/l	-	-	1.30*	-
Total coliforms	No./100 ml	-	-	-	-
Zinc	µg/l	-	-	-	-

*Less than 5 data points.

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-9

SURFACE WATER QUALITY SUMMARY
SPOKANE RIVER BELOW LONG LAKE

Parameter	Units	MEAN VALUES Jan-Mar	Apr-June	July-Sept	Oct-Dec
Temperature	°C	3.7	11.1	18.2	8.3
Dissolved oxygen	mg/l	12.9	12.3	5.8	7.7
B.O.D.	mg/l	-	-	1.4*	-
Total phosphorus -P	mg/l	0.100	0.083	0.073	0.059
Ammonia -N	mg/l	0.183	0.082	0.124	0.249
Total N	mg/l	0.656	0.416	0.765	0.861
Total coliforms	No./100 ml	418	831	954	488
Zinc	µg/l	243	209	128	70

*Less than 5 data points.

SOURCE: U. S. Department of Army, Corps of Engineers, 1976, Appendix A

Table B-10

WATER QUALITY CHARACTERISTICS OF CITY DISCHARGES TO THE SPOKANE RIVER
(in milligrams per liter)

	Quality Parameters			
Waste Flows	BOD (mg/l) ave. range	SS (mg/l) ave. range	TN (mg/l) ave. range	TP (mg/l) ave. range
AWT plant effluent[1]	17.8 8-25	19.8 9-27	11.7[2]	1.24 .31-2.72
Stormwater plant overflows[3]	31.9	83	8 3.9-14.9	1.3 .86-1.71
Combined sewer overflows[4]	115 20-210	150 76-220	9 4.3-16.6[5]	1.4 .95-1.9
Stormwater runoff[6]	19 13-25	172 138-207	3.3 .82-5.8[5]	.47 .44-.51
Satellite plant effluent[7]	40 7-73.5	37 19-55	9 4.3-16.6	1.3 .86-1.71

[1] From records of the Spokane wastewater treatment plant compiled January-June 1978.

[2] Estimated from treatment plant effluent data on nitrate + ammonia and suspended solids; 26 percent of suspended solids considered to be organic matter and 11.3 percent of organic matter considered to be nitrogen.

[3] BOD and SS from Spokane wastewater treatment plant data compiled September 1977 to June 1978; TN and TP ranges calculated from CSO quality data assuming 10 percent removal by primary treatment; TN and TP averages estimated from ranges.

[4] Range from Spokane City Department of Public Works, 1977, text; average estimated from ranges.

[5] Range from U. S. Environmental Protection Agency, 1977a; average estimated from ranges.

[6] Ranges from lab analyses of Spokane stormwater flows prepared by Spokane wastewater treatment plant staff; averages estimated from ranges.

[7] Ranges calculated from CSO quality data assuming 75 percent SS removal, 65 percent BOD removal, 10 percent TP removal and 0 percent TN removal; averages estimated from ranges.

Table B-11

SOURCES AND AVERAGE VOLUMES OF WASTE FLOWS TO THE SPOKANE RIVER UNDER THE PROPOSED CSO ABATEMENT ALTERNATIVES

	Elements of Flow (millions of gallons per year)					
Alternative	AWT Plant Discharge	Stormwater Plant Discharge	Combined Sewer Overflow	Stormwater Runoff	Satellite Plant Discharge	Export to Crab Creek
Alternative 1						
1 yr. storage	14,768.77	558	13.33			
25 yr. storage	14,781.55	558	.55			
Alternative 2	14,235	558			547.1	
Alternative 3	10,220			5,120.1		
Klicker Plan	14,782.1	558				
Latenser Plan			.463	.81		14,780.83
Combination Concept	14,212.72	*	12.19	1,115.19		
Proposed Action (1st phase)	14,198.51	*	77.13	1,064.46		
No-Action	14,235	558	547.1			

* Even though the annual flow analysis indicates there would be no stormwater plant discharge, there would probably be some stormwater plant use in peak storm conditions.

Table B-12

PROJECTED TONS PER YEAR OF PRESENT CITY LOAD
(SEWAGE TREATMENT PLANT EFFLUENT
DISCHARGE PLUS STORMWATER PLANT DISCHARGE PLUS
COMBINED SEWER OVERFLOWS) REMOVED BY EACH ALTERNATIVE

Alternative	BOD_5	SS	TN	TP
Alternative 1				
1 year storage	$0.21x10^3$	$0.3x10^3$	$-0.07x10^2$*	$0.04x10^1$
25 year storage	$0.22x10^3$	$0.3x10^3$	$-0.07x10^2$*	$0.05.10^1$
Alternative 2	$0.17x10^3$	$0.27x10^3$	0	$0.03x10^1$
Alternative 3	$0.22x10^3$	$-2.8x10^3$*	$1.64x10^2$	$1.68x10^1$
Klicker Plan	$0.22x10^3$	$0.3x10^3$	$-0.07x10^2$*	$0.05x10^1$
Latenser Plan	$1.39x10^3$	$1.72x10^3$	$7.34x10^2$	$7.99x10^1$
Combination Concept	$0.24x10^3$	$-0.26x10^3$*	$0.25x10^2$	$0.42x10^1$
Proposed Action (1st phase)	$0.21x10^3$	$-0.26x10^3$*	$0.24x10^2$	$0.39x10^1$

* Added to present city load, which is as follows:

BOD_5 = $1.39x10^3$ tons/year
SS = $1.72x10^3$ tons/year
TN = $7.34x10^2$ tons/year
TP = $7.99x10^1$ tons/year

APPENDIX C

ECONOMIC ANALYSIS SUPPORT DATA

Table C-1

ALTERNATIVE 3
STORM SEWERS - ANNUAL COST AND PRIORITY RANKING FOR IMPLEMENTATION

Overflow Group *	Storm Sewer Annual Cost	Overflow-1000 Gallons Eliminated Per Year	$/1,000 Gallons Eliminated	Priority Ranking for Implementation
1	24,290	30	810	14
2	37,450	510	73	11
3	58,710	1,890	31	5
4	44,550	340	131	12
5	1,519,360	23,420	65	8
6	251,480	5,620	45	6
7	99,130	4,560	22	4
8	1,472,170	24,750	59	7
9	180,320	280	644	13
10	119,470	1,760	68	9
11	75,920	7,300	10	2
12 & 15	2,653,730	469,970	6	1
13	48,610	2,760	18	3
14	221,320	3,910	57	10
	$6,806,510 per yr.			

*See Figure 2-7 for location of overflow group.

Table C-2

COMBINATION ALTERNATIVE - ANNUAL COSTS AND PRIORITY RANKING FOR IMPLEMENTATION

Overflow Group*	Storm Sewer Annual Cost	Storage Basin Annual Cost	Cost-Effective Technique	Overflow-1,000s Gallons Eliminated per Year	$/1,000 Gallons Eliminated	Priority Ranking for Implementation
1	24,290	31,600	Sewer	30	810	14
2	37,450	40,700	Sewer	510	73	11
3	58,710	89,680	Sewer	1,890	31	5
4	44,550	47,250	Sewer	340	131	12
5	1,519,360	1,104,640	Storage	23,420	47	9
6	251,480	232,920	Storage	5,620	42	6
7	99,130	99,280	Sewer	4,560	22	4
8	1,472,170	1,063,960	Storage	24,750	43	7
9	180,320	197,880	Sewer	280	644	13
10	119,470	93,540	Storage	1,760	53	10
11	75,920	92,420	Sewer	7,300	10	2
12 & 15	2,653,730	2,555,810	Storage	469,970	5	1
13	48,610	52,300	Sewer	2,760	18	3
14	221,320	176,790	Storage	3,910	45	8
				547,100		

*See Figure 2-7 for location of overflow groups.